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This guidebook, containing ideas and suggestions to aid the student in making a career choice, includes information about the space industry and about career opportunities in space science, engineering, and technology. Suggestions for parents, counselors, librarians, and teachers on how to utilize the book are provided. The book is arranged so that students may organize a career plan by noting special references and by utilizing the checklists at the end of each chapter. It is suggested that the guidebook be used over an extended period of time. (BC)

HIGH SCHOOL EDITION

SEVEN STEPS TO A CAREER IN SPACE SCIENCE AND TECHNOLOGY

By

Herman J. Peters   Samuel F. Angus   James J. Ves'sells

THE OHIO STATE UNIVERSITY

In cooperation with

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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PREFACE

Grateful acknowledgment is made to all who permitted, encouraged and participated in the many steps leading to "Seven Steps to a Career in Space Science and Technology." Particular gratitude is due Dr. Bruce Shertzer and Dr. Dorothy Johnson, Purdue University, for their excellent editorial work. To Miss Ruth E. Jewett, our secretary, we offer a sincere "Thank you." To all in the Educational Programs Division, Office of Public Affairs, National Aeronautics and Space Administration, we extend our deep appreciation. In particular, we are grateful for the leadership of Dr. Paul L. Gardner, Counseling and Career Guidance Officer.

We hope this book is helpful to youth, school counselors, and parents in the vocational guidance in their dynamic life dramas. With the assistance of a competently prepared school counselor, it may be a springboard for a careful career choice and its consequent implementation in happy and productive career development.

Samuel F. Angus
James J. Ves'sells
Herman J. Peters

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HOW TO USE THIS BOOK

This guidebook brings together ideas and suggestions for things to do to help with career choice; it includes information about the space industry and the world of work. The chapters present an overview of career choice related to the great opportunities in space science, engineering, and technology. It is vocational guidance for a space age.

To the Student—Most students will want to read through the entire book *first*. After the first reading many students will want to begin to organize their individual career plan, following some of the detailed suggestions offered here. Other students will wish to reread certain sections of interest. Close attention should be given to the references and checklists at the end of each chapter—these sections can be used to lead the interested person to more detailed investigation. Each reader should keep in mind that this book is designed to be used over a period of time to assist with career planning and exploration. It can serve as a reminder for further career planning.

To the Counselor—The counselor will want to have this publication readily available for students interested in space. It can be used as a guide previous to or in the course of vocational counseling. The counselor will also be interested in reading the sections on career opportunities and career trends in space. Surveying the references will provide ideas for choosing more extensive data on space careers as they may relate to a particular student's interests, aptitudes, or abilities.

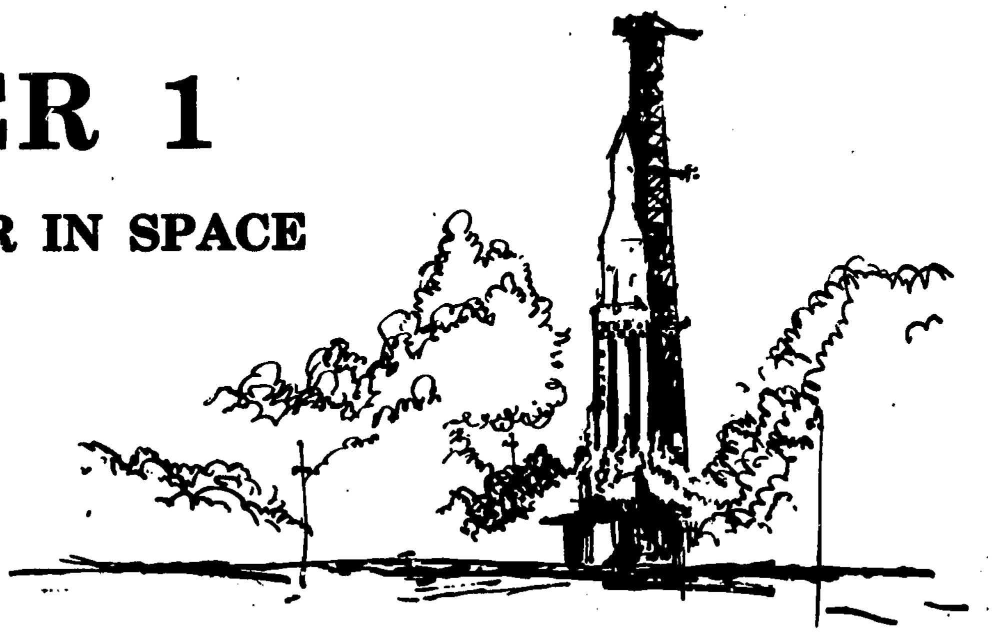
To the Librarian—The librarian may find this book useful when choosing reference material on space science and technology as well as references on career opportunities in the space industry.

To the Teacher—The teacher may use this publication as a focal point for vocational reference, particularly in dealing with articles, periodicals, films, and filmstrips on space science and career opportunities in space. The teacher may also use the book to help interested students find ideas for projects related to space science and careers in space science.

To the Parent—The interested parent may wish to read this book to get some ideas on how to assist and work with his son or daughter on career choice questions. The parent may also find the reference material helpful as suggestions for more extensive reading in both space and career choice.

CHAPTER 1

BE ALERT TO A CAREER IN SPACE



Have you thought about your career choice?

Have you thought about a career in science, engineering, or technology?

Have you been looking for a career with unusual opportunity and a future?

Have you thought about a career in the space industry?

IMAGINE—IT'S FOR REAL!

Come away for a moment in your mind's eye and imagine yourself in the blockhouse at NASA's Marshall Space Flight Center at Huntsville, Alabama. It is T minus 25 and counting. The launch vehicle is in place. Telemetry is coming into the computers; scientists and technicians are making readings and observing banks of instruments. Now it is T minus 20; the tension is building. Each worker concentrates on the task of making final checks. Nerves are taut. It is T minus 15 and counting. T minus 10. All is in order. T minus 5, 4, 3, 2, 1, ignition! The huge thrust of the Saturn booster engine is unleashed. The vehicle does not move. This is a test, a static test. This is just one of the many tests in the Apollo project.

The Apollo project, as you may well know, has the goal of putting men on the moon in this decade. For every vehicle that is launched in moving toward that goal, thousands of experiments, tests, and simulated runs are conducted to perfect every aspect of the equipment and the human activity related to the shot. Anyone thinking of entering a space career must be aware that much activity—success and failure—precedes every successful launching. Each time a space shot is made, a great deal of preparation has been carried out involving space scientists, engineers, and technologists. So it is with you—if you plan to point toward a space career—preparation, hard thinking, and honest self-appraisal are required.

WHAT YOU SHOULD KNOW

That we are in the midst of a technological revolution is a well-known fact. The need for skilled and professional workers increases yearly, while the need for unskilled workers continues to decline. The space industry is a manifestation of the technological revolution. Its occupations (aerospace technology specialties) represent one of the fastest growing fields in the United States today. There are great opportunities for scientists, engineers, and technologists in the space industry. In 1964, a shortage of trained people existed in this field and present trends indicate that even greater shortages will occur in the future. The need for scientists, engineers, and technologists is very clear. Many rewards are to be gained by those who work in areas presenting so great a challenge. Couple these two—challenge and reward—and you are faced with many career opportunities.

JUST THINK ABOUT THE TREND AND YOURSELF

The space industry is expected to continue its rapid growth. High school girls and boys should be alerted to this impact upon them—directly or indirectly. Many may wish to investigate a career in space science and technology.

STEPS TO HELP YOU TAKE ACCOUNT OF YOURSELF

This book suggests seven steps you can use as a guide to explore a career in space science and technology. The first step is that of *Alerting Yourself to the Possibility of a Space Career;* it will be dealt with in the remainder of this chapter. Just for a starter, it is important to be alerted to some of the activities of the space program of the United States, the many considerations to be thought about when pointing toward a space career, and the necessity of early planning.

The second step, that of *Beginning To Explore the Space Industry,* is designed to help acquaint you with the space industry. This chapter deals with man's various definitions of space, and then shifts to thoughts about the space industry by answering the questions of "Who?" "Where?" "What?" "When?" "How?" and "Why?" as they relate to the space industry.

The third step is that of *Considering Occupational Fields in the Space Industry.* Chapter III is designed to help you become acquainted with the general areas and specific groups of jobs in the space industry to which you might aspire.

The fourth step is that of *Determining Pathways to a Job in the Space Industry.* This fourth chapter focuses on the educational backgrounds that you will need for different job fields.

The fifth step is that of *Exploring Job Requirements in the Space Industry.* Chapter V helps you learn about the requirements and expectations that are related to jobs in science, engineering, and technology.

The sixth step is to assist you in *Formulating Goals for Now and in the Future.* Chapter VI helps you to look at yourself and suggests factors to consider when a person determines his goals.

The seventh step focuses on the *Expanding Horizons of the Space Industry.* This final chapter tells you of the trends in the space industry, indicates what these trends hold in store, and elaborates on how you might keep up to date as breakthroughs and discoveries emerge to influence and change the trend.

At this point, let us return to the *Alert.*

DO YOU KNOW WHAT IS GOING ON IN SPACE?

There are many activities in the United States space program. Satellites are being used in studies of weather prediction, navigation, communication, and astronomy. The manned space exploration program is familiar to you through the manned sub-orbital and orbital flights of Project Mercury and the two-man flights of Project Gemini, as well as a series of flights in the Apollo Project. The next step will be missions to other planets and beyond! To achieve such an ambitious program, the development of high-thrust boosters is well along; superior guidance and control systems are being perfected; and massive ground facilities for assembling, testing, and launching are being developed. The universities of our nation have a vital part in the program. They accept much responsibility for increasing our scientific knowledge through research and better preparation of students.

HOW DO THESE SPACE ACTIVITIES AFFECT YOU?

The research, development, testing, and production related to space exploration touches your life almost daily. Radio and TV broadcasts report the latest happenings. Newspapers, magazines, and books report on the progress of the projects and speculate on their many implications. It is likely that your thoughts and conversation often turn to the latest space accomplishments. At times you may even dream of what the future will bring.

Space exploration has already contributed to your life in many practical ways. Some of the more beneficial results are greater national security, a strengthened national economy, new jobs, higher living standards, new consumer goods, improved education, advances in medicine, and stimulated business enterprise. You may reap some or all of these indirect benefits of space exploration.

WHAT PART CAN YOU PLAY IN THESE SPACE ACTIVITIES?

As the space industry expands and the need for scientists, engineers, and technologists continues you may wish to examine the space industry as a place of future employment. You may become the scientist who develops a new way of propelling spaceships, perhaps ionic or nuclear. Imagine yourself as the engineer who designs the new space vehicle, or the technologist who assembles the components of a large space station in orbit. Or you might work in another capacity to assist in the solving of some of the myriad of problems related to space exploration. If you are interested in exploring a career in space science and technology you must focus on the preparation dimensions that are involved.

DIMENSIONS TO CONSIDER WHEN YOU ARE POINTING TOWARD A SPACE CAREER

How well do you know yourself?

Do you know about the qualifications needed for occupations in space industries?

Do you know about the world of work?

These are important considerations for any job—have you thought about them?

ARE YOU AWARE OF YOUR INTERESTS AND YOUR ABILITIES?

Your interests and your abilities go hand-in-hand when planning your career development. It is, of course, logical that if you have only interest and little ability, you cannot achieve in the career field. By the same token, if you have the ability to perform, but little interest in a career, you would be ill-advised to choose it for your life's work. Thus, you must have both interest in, and ability for, the career field you choose.

YOUR INTERESTS. Why not stop for a moment and ask yourself what your interests are? What school subjects do you like best? What sports, hobbies, clubs, and odd jobs do you engage in? What type of music do you like? What kind of reading do you do? Have you noticed that your interests have changed, or are they the same as earlier? Have certain people that you have come to like affected your interests? Why not go back and read these questions again, trying to answer each one just a little more fully?

If you are not satisfied with your answers, you may wish to make an appointment with your guidance counselor and inquire about taking an interest inventory. An interest inventory may help you to think more deeply about your interests and help you to relate your pattern to occupations. Remember, however, that *an interest inventory cannot tell you if you have the ability to perform well in a certain occupation.*

YOUR ABILITIES. Give serious consideration to the abilities you possess. What can you do best? What indicators do you have of your abilities? You might start by thinking about the grades made in some of your school subjects; for example, in mathematics, science, and English. Which represented your strengths? Which were your weaknesses? Other indicators of ability are scores on achievement and aptitude tests. What do these scores indicate about you? It may be necessary to make an appointment with your guidance counselor to get your test results and an interpretation of the test scores. When you see the counselor, you may also be able to get an interpretation of your intelligence test scores in terms of possible career plans. You will also want to discuss your career plans with your guidance counselor, your parents, and your teachers. By looking over these indicators of ability carefully, you can get an idea of your capacity to perform at various levels. It is extremely important to get a clear idea of your ability so as not to point toward a career field that is out of reach for you. Yet it is equally important that you choose a career field that will challenge you to work commensurate with your abilities. This will make your career more rewarding.

WHAT ABOUT YOUR PERSONALITY?

As you look at yourself in order to learn more about your interests and abilities, it is also wise to look at other significant personal attributes. An individual's personality is one important factor in how successful he is on the job. You might want to take note of how well you get along with your friends and teachers. You might want to focus on your problems. How well do you handle them? Do you often feel extremely uncomfortable in classes or at social gatherings? Are you always a follower, or do you share in initiating and making your ideas known? Are you dependent on others or independent? Are you dependable or undependable? These are just a few of the many factors related to a person's personality. You might want to take a closer look at your personality on your own or you may want to discuss it with someone, such as your guidance counselor, friend, or parent. You may be interested in taking a personality inventory which, when interpreted and discussed with a professional counselor, can help you to know yourself better.

LEARN ABOUT QUALIFICATIONS

If you point toward a career in space, you must meet requirements in science, mathematics, and have certain technical skills. Of course, not everyone in the space industry will be required to be the very top scientist, mathematician, or technically skilled person, but your mastery in these three areas will determine your placement, and how quickly you advance. In the space industry, there are places for men and women who have different levels of competency in science, mathematics, and technical skills. You may specialize in one field more than the others; you may have considerable qualification in all three; or your levels of competency may vary among the three areas.

WHERE IS THE EMPHASIS?

We have stated that three important areas of qualification are science, mathematics, and technical skill. What does this mean?

Emphasis on Science. There are many sciences such as physics, chemistry, psychology, physiology, psychiatry, and earth science to name but a few that are related to space exploration. The content dealt with in each and the way it contributes to space exploration varies widely, but there are common threads among the sciences—attitudes that are held in common by scientists in each area. One general type of common thread is what might be called "scientific literacy" and a more specific common thread is the scientific method.

WHAT IS SCIENTIFIC LITERACY?

For most people, to be "scientifically literate" is not something you are or are not, but rather a foundation you develop. It means a continuing awareness of what is new in science and technology. It means understanding the general workings of the world and outer space. It means to be alert to the affect of science and technology on our daily living.

The nature of scientific literacy needs to be examined in greater detail. First, a person's scientific literacy is based on his or her knowledge in science—a kind of knowledge that is broader than mastery of detailed information. It is a knowledge that includes the qualities of curiosity, accuracy of observation and interpretation, and open-mindedness. Thus, if we studied a person who was a scientific literate, we would likely find that he is curious about the "How" and "Why" of the world as well as the way people behave. He will also be genuinely interested in hearing and reading about activities of scientists. A person can have scientific literacy without creating the new ideas of science, but he would certainly be able to converse about and communicate the important new and general ideas and theories that are developing in the halls of learning, in the research laboratory, and on the job. *It does not mean knowing the many details of scientific knowledge.*

Perhaps one of the more important evidences of scientific literacy is the person's desire to determine the true quality of an idea and to be openminded about one's own ideas and those of others. He strives to be accurate and precise in his observations and descriptions. When more information is available, the person will be ready to adjust his thinking in terms of the new information. He will demand this painstaking accuracy in others, and will insist on being given the basis for making a judgment about ideas. This whole approach will carry over into all areas of the person's life, such as his philosophy of living, foreign affairs, and music.

Thus, scientific literacy includes the person's knowledge of facts, concepts, and principles, but does not stop there. It also indicates the individual's attitudes and his application of knowledge. It is important to note that so-called facts and even concepts and principles have a tendency to be modified or completely changed as new discoveries and breakthroughs come about. This, related to the idea of scientific literacy, would mean that the person would also have to change and modify to keep pace.

At this point, let us focus on you again. In this time of the "explosion of science and technology" how is your scientific literacy? It is really rather obvious that every citizen of a highly developed nation such as ours might have a high level scientific literacy. Those in the space industry must have a higher than average level of scientific literacy. Can you qualify?

WHAT DO YOU KNOW ABOUT THE SCIENTIFIC METHOD?

The "scientific method" is the more specific common thread that was mentioned among the sciences. You may say, "Oh, I know all about the scientific method; we studied that in science class." The fact is that no one knows all about the method, for different types of problems require new and varied applications of the method.

Experts say that the scientific method is a formal approach to solving problems. Different experts speak of different steps in the method. The following are the six steps often referred to:

1. define the problem—limit and concisely state the problem;
2. state hypotheses—statements of possible solutions for the problem, sometimes called educated guesses;
3. experiment—devise a way to control the situation by limiting the aspects dealt with so as to focus study on the problem;
4. collect the data—sum up the findings after the study;
5. come to a conclusion—on the basis of the data, decide upon the best answer to the problem;
6. remain open-minded—be ready to consider, accept, and use a solution that can be shown to be a better answer to the problem.

If we look to this method for solving problems in relation to space, it is obvious that there is an unending application of the method. Man's space exploration has opened an infinite unchartered expanse, thus generating an infinite challenge of problems and solution. The scientific method is extremely useful in these pursuits.

Space exploration demands variation of the application of the scientific method to solve unique problems. Therefore, the student who takes advantage of every opportunity to learn and to practice the use of the scientific method will likely be better prepared to work with problems of space.

EMPHASIS ON MATHEMATICS

Mathematics is also a science, and is sometimes referred to as the most exact science. The question is often asked, "How much mathematics do I have to know to do that job?" It is true that mathematics is important in relation to scientific, engineering, and technological endeavors; however, different levels of mathematical competency are required. Certain technical positions may require only algebra; others require mathematics into calculus. Different sciences also require varying mathematical competencies; for example, specialization in geology and physiology requires calculus, while specialization in psychology and zoology usually requires mathematical competency through calculus and into differential equations. Of course, the person who specializes to the greatest extent in mathematics is the mathematician. This brief discussion indicates that mathematics is important for a space career, but the door is not closed to those who have high competency in certain fields not requiring as much mathematics.

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How do you rank in mathematics? Today, the trend is toward more fields requiring greater mathematical competency. The person skilled in mathematics, therefore, will find considerable employment opportunity in the years ahead.

EMPHASIS ON TECHNICAL SKILLS

The technical skills required of those in space careers vary widely. It may be that among other competencies the astronaut possesses the highest level of technical skill in certain areas. For example, astronauts have to fly simulated missions to perfect their skills in controlling the yaw, pitch, and roll of their space capsules. In fact, even eating becomes a technical skill in space.

Other examples of technical skills may range from the polishing of lenses by a technician, to technical report writing, to operating a computer, to giving an injection to a chimpanzee, to drawing the plans for a satellite, to using a slide rule, to micro-welding, and even to sterilizing a satellite. Scientists will have certain technical skills; engineers and technicians will, as well, employ technical skills. Drafting is a technical skill which is often common to all three. Is drafting one of your skills? Technical skills are important in one's training. Your choice of career fields and your level of aspiration in that field will determine the skills you will need to master.

LEARN ABOUT THE WORLD OF WORK

Your alertness to the possibility of a career in space, or a career in any field for that matter, would not be complete without thinking about the world of work. In this era of increasing specialization, more people are spending more time in school. Few students, however, do enough thinking about the day they will leave school and become employed. This section will introduce some ideas about how you may prepare more satisfactorily for the work world.

ARE YOU AWARE OF THE WORLD OF WORK? In society, we have an understanding that as each person becomes prepared, he will enter the world of work in some capacity. Too many people enter a specific job on the basis of chance alone. It would be more efficient and enjoyable for all concerned if people could find jobs in which they are interested, and for which they are trained, not just the jobs they happen into. If this is to be possible, each person must acquaint himself with the world of work in advance of the time he is to enter. One might start by thinking a little about the changing meaning of the word "work."

THE MEANING OF WORK CHANGES. If we go far back in history, we find that the Greek word for work was *ponos,* meaning pain. The same root is in the Latin word for work, *peona,* and here it implies sorrow. For these people, work was burdensome and connected with fatigue. Today, machinery is used for most of man's heavy work, and the emphasis is now on man's training, skill, and brain power.

Returning to history, we discover that the Hebrews were like the Greeks in regarding work as painful drudgery. Work no longer has this meaning of being connected with slavery and bondage. Today, man has a choice and can enter work to his liking. But he must exercise his choice.

It has been said that through work, we have the possibility of unlimited progress. It is clear that man's great triumphs by means of science and technology have led to undreamed of discoveries and advances. In fact, some believe that there are no bounds to man's creative power and his ability to progress through work. It has been said that there is no enemy that cannot be conquered—time, space, poverty, sickness, old age, and even death itself.

With today's radically different view of work, man is able to derive great meaning and satisfaction from working. Couple this with man's increasing awareness of his ability to exercise a choice as to his field of work, and it becomes clear that work has a prominent positive place in man's life.

NATURE OF JOBS CHANGE. How do today's jobs compare with those of yesterday? For the most part, modern American jobs are no longer of the independent, self-sufficient, small-farmer, pioneering, or rough individualistic type responsible for this country's founding and growth. Today, the greatest number of Americans are employed in some capacity by large corporations. This means that these people are skilled not only as engineers or technicians, but also have know-how in organization, coordination, teamwork, planning, theory application, and large-scale execution.

The trends in automation have also affected jobs today. The coming of automation has taken inventiveness from the workroom and moved it to the drafting board, and the laboratory. The coming of automation has influenced jobs in an important way that we have mentioned earlier—skilled jobs continue to rise while unskilled jobs decline. Automation and other new processing techniques have made it possible for more work to be done in less time. This has, in turn, brought about shorter working hours in many fields. The pressing question confronting many is what to do with their leisure time.

LEISURE TIME. The rise in leisure time has presented a new challenge to many. How will people use this time? This may not become a question for you if you learn to use your leisure time wisely while still in school. Many students find time to take courses or become involved in activities related to photography, music, art, ceramics, aviation, numerous sports, camping, dancing, dramatics, and other special interests.

A portion of the problem is solved when a person comes to be aware of his special interests and develops them. It is often possible to locate organizations in the community whose members have interests similar to yours. You may affiliate with them and find others who appreciate your interests. The appropriate use of leisure time depends on being aware of your likes and exercising initiative necessary to get involved.

The use of leisure time is a critical issue. Some maintain that man's use of his leisure time in a constructive and productive way may very well decide the fate of man on earth. This statement has many implications. Why not take a moment to ponder it before going on?

PLANNING AHEAD

Choosing a career demands that you learn about yourself. It requires that you learn about the qualifications for a career. It necessitates study of the work world. But, unless you use this information to *plan ahead,* all this knowledge will be of little use.

Importance of Planning. In the past, when occupations required much less specialized training and know how, a person did not have to concern himself as much as in the present with planning a career and training for a career. He might have waited until he finished school and then chose his career. Now, in the space age, if a person is thinking of a technical or professional career, he must consider in advance his abilities, his interests, possible career fields, and needed education.

As a nation, the United States has committed itself to the peaceful exploration of space. This includes landing a man on the moon in this decade. To achieve such an extremely challenging, imaginative, and technical undertaking, we cannot start in 1968. Lead time must be considered. The actual manned shot to the moon must be preceded by activity including planning, building, training, perfecting, and further perfecting. All this involves both people, equipment, and time for the accomplishment of each activity. A master plan is to be conceived to bring together all of the perfected equipment and the trained individuals to operate it at the time designated in the future. This undertaking involves thousands of people and billions of dollars.

Your career development is of no less importance to you. The career you choose will determine what happens to you in the major portion of your life. It is clear that planning ahead is necessary, but what should be the nature of your plan?

NATURE OF PLANNING

If you look about yourself today, one important characteristic of your world of work is evident and that is *change.* We are in the midst of a number of explosions—science, knowledge, and population. All of these explosions mean change. The rapid pace of change in technology, education, and society puts man in a position of having to be more flexible and adaptive to keep up.

Space science and technology are rapidly developing and changing fields. Therefore, if your plan is to point toward a career in space science or almost any other field, you must have a plan that can be changed according to your needs as they change.

With all of the emphasis on planning, it is only logical that you take some time out now for planning. The following is a guide[1] to help you think more about yourself in preparation for your career choice. It may be helpful for you to complete it and then discuss it with your parents, school counselor, or teacher.

[1] Based on *My Career Guidebook* by Harry S. Belman and Bruce E. Shertzer. Milwaukee, Wisconsin: Bruce Publishing Company, 1964, 48 pp.

I. Personal Preferences on the Work Situation

A. Check ✓ those which you like and x those which you dislike.

____ 1. Work situation involving handling and/or management of money.
____ 2. Work situation in which I would care for other people.
____ 3. Work situation requiring acceptance of responsibility for others.
____ 4. Work situation where I would sell things.
____ 5. Work situation involving the use of mathematics.
____ 6. Work situation requiring individual decision making.
____ 7. Work situation where I would spend time with children.
____ 8. Work situation requiring thinking fast.
____ 9. Work situation in which I would meet many people.
____ 10. Work situation depending on writing skill.
____ 11. Work situation where I would use my physical strength.
____ 12. Work situation where planning and organizing is central.
____ 13. Work situation requiring frequent moving.
____ 14. Work situation involving noise.
____ 15. Work situation outdoors.
____ 16. Work situation indoors.
____ 17. Work situation where I use my hands and/or work with tools and machines.
____ 18. Work situation requiring patience and accuracy.
____ 19. Work situation where I work with other people.
____ 20. Work situation where I have to take orders.
____ 21. Work situation which is clean and orderly.
____ 22. Work situation where I would be alone.
____ 23. Work situation involving ideas and original thinking.
____ 24. Work situation requiring close attention to time.
____ 25. Work situation requiring study and research.

B. List other personal preferences you have involving the work situation.

	Why do you have this preference?
1. ____________	____________
2. ____________	____________
3. ____________	____________
4. ____________	____________

C. List other personal dislikes you have involving the work situation.
Why do you have this preference?

1. ______________________ ______________________

2. ______________________ ______________________

3. ______________________ ______________________

4. ______________________ ______________________

II. How Do You Stand in Achievement, Ability, and Interest?

A. Rate yourself on your performance in the following subjects:

Subjects	Check ✓ *Below Average*	*Average*	*Above Average*
1. Science	______	______	______
2. Mathematics	______	______	______
3. English	______	______	______
4. Technical skill courses	______	______	______
(drafting)	______	______	______
5. Shop or industrial arts	______	______	______
6. Foreign language	______	______	______
7. Social studies	______	______	______
8. Speech	______	______	______
9. Physical education	______	______	______
10. Music	______	______	______
11. Business courses	______	______	______
12. Home economics	______	______	______
13. Agriculture	______	______	______
14. Others	______	______	______

B. General Abilities—How do you rank?

Abilities	Check ✓ *Below Average*	*Average*	*Above Average*
1. In your high school academic studies	______	______	______
2. In your skill in using tools and mechanics	______	______	______
3. In your high school technical courses	______	______	______

Abilities (continued)	*Check* ✓	*Below Average*	*Average*	*Above Average*
4. In your ability to visualize in three dimensions				
5. In your ability to do eye-hand coordinated work				
6. In clerical work				
7. In artistic work				
8. In scientific work				
9. In mechanical work				

C. Occupational Interests—Which categories from the Kuder Preference Record do you like most and like least?

Categories	*Check* ✓	*Like most*	*Like least*
Outdoor			
Mechanical			
Computational			
Scientific			
Persuasive			
Artistic			
Literary			
Musical			
Social service			
Clerical			

D. What other activities are you involved in?

List organizations, clubs, or teams in which you are involved.

What responsibilities have you held in this group?

E. What is your usual recreation?

Why do you like it?

F. What are your hobbies? Why do you like these hobbies?

III. How's Your Health?

A. How is your weight for your height? ______
B. How is your eyesight? ______
C. How is your hearing? ______
D. Do you have any speech problem? ______

IV. Care of Your Health

A. How are your sleeping habits? ______
B. How are your eating habits? ______
C. How are your exercising habits? ______

V. Your Study Habits

A. What subjects are you taking this year?	Why did you take them?	Why do you like or dislike them?
1.		
2.		
3.		
4.		
5.		
6.		

B. Study Habits	*Always*	*Usually*	*Never*
1. Do you make a record of all assignments?			
2. Do you have a particular study time?			
3. Do you have a particular study place?			
4. Do you gather important study tools before you start to study?			
5. Do you put off your study?			
6. Do you use study time for other purposes?			
7. Do you keep your mind on your studies?			
8. Do you look over your whole lesson before working on it in parts?			

B. Study Habits (continued)

	Always	*Usually*	*Never*
9. Do you look over and recall the main points in the lesson as part of your study plan?	______	______	______
10. Do you review what you studied before going to class?	______	______	______
11. Do you finish your assignments on time?	______	______	______
12. Do you spend too much time studying?	______	______	______

C. How might you improve your study habits?

______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________

VI. Your Work Experience

A. What jobs have you held?	Did you like or dislike them?	Why?
1. ______	______	______
2. ______	______	______
3. ______	______	______
4. ______	______	______

B. What kind of occupations do you feel most fit to do?

Kind	Why?
1. ______	______
2. ______	______
3. ______	______
4. ______	______
5. ______	______

LEARNING MORE ABOUT SPACE CAREERS

Now is the time to learn more about the space industry. You may wish to return to your planning guide answers as you learn more about space careers. These answers may help you to see how you might fit into the space industry.

Helpful Reference

Robert Calvert, Jr. and John E. Steele. *Planning Your Career.* New York: McGraw-Hill, 1963, 152 pp.

Provides the student with the tools necessary for career planning. The suggested methods for handling the job interview, preparing resumes, handling correspondence, selecting the right job, and many other helpful pointers not generally found in any school situation, are among the strong points of this excellent book.

A. H. Edgerton. *A Career-planning guide.* Chicago: The World Book Encyclopedia, 1956, 40 pp.

A career guide which has been designed for use by the boy or girl who is planning a career with his parents help.

Walter M. Lifton (ed.). *Keys to Vocational Decisions.* Chicago: Science Research Associates, Inc., 1964.

Topics related to vocational decisions are discussed particularly with the high school student in mind. Some topics included are interest, personality, and tests.

CHAPTER 2

BEGIN TO LOOK AT THE SPACE INDUSTRY

Is the space industry important to you?

Are you going to be a part of the space development?

Why are we in space?

What space developments change our world?

INTRODUCTION TO SPACE— A NEW INDUSTRY

If a reporter were to look at career opportunities in the space industry, he would probably take a journalistic approach and consider the *who, what, when, where,* and *how* of space science, engineering, and technology. Each occupation within the industry could be described in many different ways. Implications important to career development exist within each division. Since space is one of the newest and fastest growing industries in the Nation, all the facts should be considered. Opportunities for careers in space, to be meaningful, must be related to you—the reader!

WHAT ARE THE DIMENSIONS OF SPACE?

Everyone has an idea of what space is, yet there is no simple way to define the exact dimensions or limitations of "space." Space certainly includes the concept of infinity. Depending on what basis you start with, one might argue that space begins at the point where man can no longer breathe naturally, without obtaining oxygen artificially. This is about three and one-half to four miles above the earth's surface. Others state that space begins at the level below which 99 percent of the atmosphere lies, which would be at an altitude of twenty miles.

Another place to start toward this infinity would be at a point at which aerodynamic vehicles can no longer be supported by the atmosphere. This is nonspecific, varying with the type of vehicle. A point where meteors first appear, seventy-five miles out, could be used.

In this book "Space" will mean the atmosphere beyond the twenty-mile level of the earth's atmosphere. This includes interstellar space. "Space flight" will include flight beyond the sixty-mile level, below which lies all but one-millionth of the earth's atmosphere.

From the surface of the earth, to these levels and on to infinity—this, then, is aerospace, air and space. Space is thus that part of the universe between celestial bodies and stretches infinitely beyond this atmosphere.

SIX QUESTIONS TO CONSIDER ABOUT SPACE

There are many dimensions of each space consideration. The questions of *who, where, what, when, how,* and *why* could be concerned with space itself, but more importantly should be related to your preparation for a career in space science, space engineering, or space technology, all part of the new space industry. The focus, then, will be upon you as a student in the high school preparing for a future career within the space industry.

WHO ARE THE WORKING MEMBERS OF THE SPACE FAMILY?

The great majority of people in the space industry are highly skilled and semiprofessional employees of private industry, who do not work directly for the Government. People in space industries come from various socio-economic levels, and possess many varied skills, talents, and experiences. They are men and women who have differing amounts of education and training, but they also have many things in common. They all have kept up with the times and continued to increase their knowledge.

Besides the scientists, engineers, and technicians, members of the space industry include the military specialists from all branches of the service, the astronauts, the university research people, educators, contractors of every type, and subcontractors. There are also people in administration, management, finance, and other services including supply, repair, and maintenance. Many employees of well-known manufacturing concerns are indirectly members of the space industry family; for ninety percent of the materials are designed, developed, or manufactured by American industry.

In fact, *you* are one of the most important members of the space family. As an American student and future taxpayer you are a determining factor in space development. Americans have already invested more than five billions of dollars in the years ahead.

You are a stockholder as well as a recipient in a pyramiding industry. It is up to you to see that your investment will pay compound interest in providing a better way of life--new opportunity for you and those that follow.

A few short years ago the astronauts and those now in training were in high school, just as you. A few years from now they or others like them may be managing a new world—one you may visit. By your actions, your preparations, you will have helped prepare others, if not yourself, for space travel.

The space industry is exploding with new job opportunities that were relatively unknown in 1960. Each new space discovery, each development, sets off a chain reaction in industrial growth as an entirely new industry emerges on the contemporary business and industrial scene.

You are preparing for this new industry when you study advanced mathematics, science, economics, language, and government. You become involved when you do term papers (introductory research), operate machines (mechanics), engage in tests (psychological measurement), and in a host of other school activities which relate to space communication, automation, data processing, and instrumentation.

With you, in these involvement processes, are your teachers, counselors, school administrators, even your parents, and friends. They all must help create an educational climate that will help you be prepared for the space age. Educators in key positions in our government and elsewhere have grasped the opportunity, born of necessity, to change outdated concepts. Their goal is to prepare you better for the new world of tomorrow.

Among the planners in government are the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), the Atomic Energy Commission (AEC), the Department of Labor (DOL), the Department of Health, Education, and Welfare (HEW), and the Department of Defense (DOD). Many others also are concentrating their special talents and efforts to establish a better standard and organization for living in the space-age society.

Others with key roles in preparing young Americans for their future are the universities, colleges, technical schools, research foundations, and academies. Industrial training is a vital part of this educational preparation. Major universities such as the Massachusetts Institute of Technology, Purdue University, Rice Institute, The Ohio State University, the California Institute of Technology, and many, many others are performing vital research while at the same time providing the classroom teacher with fundamental knowledge for space leadership.

Many people are working with you, the high school student as the focal point, to insure that the space world of today and tomorrow will be a matter of intelligent conquest.

The entire world is fast becoming adapted to, even obsessed with, their almost inescapable role in space development. Our discoveries in space, the integration of new knowledge and communication capabilities, may do much to press this world's technical and scientific activity into a closer unity—for a more coherent harmonious society.

WHERE IS THE SPACE INDUSTRY? WHAT DO WE MEAN BY THE SPACE INDUSTRY?

The space industry is on the East Coast, the West Coast, in Florida, Alabama, and Texas with the hub of administrative activities in Washington, D.C. The space industry may be located at an airport, on a campus, on a mountain top, a desert, in a factory, at a rail or shipyard. In fact, it can be and is located in nearly every state.

When people think of the space industry they naturally think of the National Aeronautics and Space Administration—a government agency. Yet more than eighty-five percent of all the money spent for space goes directly into private industry. Many of the workers employed in space industries are employed by private industry. The function of the role of government in space should be understood.

NASA

The National Aeronautics and Space Administration (NASA) is an independent civilian government agency established October 1, 1958. Broadly, NASA's mission includes all matters pertaining to civilian aeronautical research but also the development, construction, testing, and operation for research purposes of aeronautical and space vehicles, manned and unmanned, together with related equipment, devices, and components.

NASA's work includes basic and applied research for the expansion of human knowledge of phenomena in the atmosphere and space; the improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles; the development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space; and the preservation of the role of the United States as a leader in aeronautical and space activities.

NASA is a relatively new agency, but its competence and expected standards of performance are based solidly on the accomplishments, personnel, and facilities of the long established and well-known National Advisory Committee for Aeronautics, plus major segments from other Federal agencies that have been transferred by Executive Order of the President into the NASA organization. These have included elements of the Naval Research Laboratory, the Army's von Braun rocket development team, and the Jet Propulsion Laboratory operated under contract by the California Institute of Technology.

NASA employs nearly 35,000 people, most of whom are located in seven major research and development centers. About one-third of the total are scientists and engineers. Over two-fifths are skilled craftsmen and technicians, and one-eighth are clerical workers. About one-twelfth are administrative personnel.

NASA's work within its own laboratories is only a part of its larger responsibilities for a national effort in aeronautics and space exploration. More than ninety percent of the total NASA funds are expended for research and development outside the government with NASA performing technical and administrative monitoring. The space industry is primarily involved in the development of hardware items and flight systems, with universities and other non-profit institutions participating in the supporting research.

NASA HEADQUARTERS, WASHINGTON, D.C.

Within the framework established by Congress and the President, NASA Headquarters plans and directs the Nation's civilian space effort. Centered here are policy formulation, direction, and control for NASA's major programs. These are: (1) manned space flight, including manned lunar exploration; (2) space sciences, in terms of unmanned scientific investigation of space, the moon, and the planets; (3) practical applications of space technology, including operations, weather, and communications satellites, and (4) advanced research and technology in both aeronautics and space. The Headquarters also bears the primary responsibility within NASA for promoting international cooperation in aeronautics and space research, keeping the general public and the scientific community informed about NASA operations and research findings, and developing the necessary agency-wide administrative management systems to support the total NASA program. The major centers are engaged in research, development, and operations relating to the manned and unmanned space exploration and peaceful use of space. Most of these have management responsibilities for projects dealing with extensive development contracts in industry.[1]

Space industrial research also includes schools. For example, in 1962 more than half of NASA employees were attending some sort of formal training program. This does not include numerous other employees who took unsponsored educational or training courses to improve their potential.

How does NASA operate? Government scientists initiate (theorize, synthesize, and evaluate) a space project or program. They call in experts in the engineering area who construct models, prototypes, designs, or plans. Further evaluation follows. The production of the model or models is then "farmed-out" to various civilian *contractors* who in turn farm out portions to many *subcontractors* and *suppliers*, all in private industry. Often the facts, figures, specifications, and details are fed into computers and continuously studied as each aspect of a new model or project is developed. This is checked by the scientists, engineers, and other experts in NASA and in other government agencies, even congressional committees.

Much of the initial research and feedback is "farmed out" or contracted to major universities, laboratories, planetariums, or research foundations with NASA structuring the contract specifications as to quality, performance, time, and costs.

NASA monitors the entire space effort. It develops the contracts, coordinates and integrates the project activities with all interested civilian, military, and government agencies. The majority of the actual research and production, manufacture, fabrication, transportation, support, and labor is performed by civilians—private citizens, working in American industry.

The space program is world-wide. Space activity is international and interdisciplinary. It involves almost every country and climate. For example, you may find space technicians and engineers on tropical beaches, or in the jungles of Africa or South America; you may find observers and scientists in their laboratories atop a mountain or skyscraper, in an office or laboratory. In arctic or tropic wastelands, you may find monitoring stations, transmitting stations, experimental stations. These various stations are sometimes a great distance from the research centers, the flight test centers, or communications centers of the Nation.

An increasing amount of the space research is conducted in the Nation's universities, research foundations, academies, and other campus settings. Space programs are also found interlaced with military programs and those of other government agencies.

The scientists, the technicians, the engineers, the educators, the government officials, all focus their interest on the space laboratories that soon will be launched into orbit to function as another planet. Some of those now working around the earth, may soon transfer their activities to a lunar or planetary experimental station. Their moving van will be a rocket-powered space vehicle.

The Department of the Army's missile test center in El Paso, the Department of the Navy's nuclear-powered submarines with their Polaris missile capability, are part of the space industry family. The United States Air Force and its vast network of intercontinental ballistic missiles, its ultrasonic aerospace craft, and its vast communication and radar network provide the military management of space. Aerospace medical centers work with civilian researchers to provide the physiological and psychological processes necessary for space flight.

New fields of interest in space law, space medicine, space communication, and an entire field of a new geology are now being studied in research centers, mostly on the college campus. This means that you as a graduate student in

[1] *Historical Origins of the National Aeronautics and Space Administration*, U.S. Government Printing Office, Washington, D.C., 20402.

college will have an opportunity to be a part of vital space research.

The Union of Socialist Soviet Republic, the United Kingdom, France, and many other countries are devoting great efforts toward space research. Some of this research is cooperative with the United States. International cooperative research brings into focus such areas as diplomacy, international relations, foreign language, and international law.

The space industry is, then, the civilian and military agencies of the government working with the universities and research centers to provide space development. This work is accomplished almost entirely by private industry.

WHEN AND HOW WE GOT IN THE SPACE BUSINESS

Over seven hundred years ago the Chinese, having invented gunpowder used rockets to repel the invading Mongols. In the centuries that followed a more entertaining use was made of rockets, in the form of fireworks. Military personnel then discarded rocket power in favor of the cannon. Yet, from time to time, English and French military personnel revived their interest in rocketry with mixed success. It was not until the twentieth century that scientists began to relate the idea of space travel with rocketry, or the military began to develop a controllable missile.

A Russian school teacher, Konstanin Tsiolkovsky, in 1903, published an article on the possibility of sending a rocket into space as an exploration vehicle.

Space exploration vehicles, whether manned or unmanned, must have a propulsion system, some sort of guidance or control system, have some purpose or payload, and have a framework to unite the various parts. Until the twentieth century rockets were largely without all of these required components.

Until recently, our access to outer space lay entirely through light and other radiations that penetrated earth's atmosphere from the vastnesses of the universe. With the advent of the modern rocket or space exploration vehicle, great new vistas opened before us. It then became possible to send observation equipment above the obscuring and distorting atmosphere to observe the universe.

As technology advances, more and more of the solar system will become accessible to direct observation by means of instruments carried in rocket-powered vehicles.

The rocket makes all this possible, not only because of its ability to hurl itself away from earth, but also because it can operate in a vacuum. Even in 1865, these abilities of the rocket were recognized by French author Jules Verne, who included in his fictional account of *From the Earth to the Moon,* rockets for steering a spaceship. However, Verne's spaceship was launched from a cannon.

Between 1914 and World War II, Dr. Robert H. Goddard, an American physicist, conducted extensive research on rockets. His principle motive was to find a way to explore the earth's higher atmosphere. Goddard's early analysis of the problems of rocket propulsion were complete and remarkably accurate. In 1926, he conducted the first successful test of a liquid fuel rocket. However, his early efforts and those of other rocket enthusiasts went largely unheeded.

Considerable interest in rocketry arose in Germany in the early 1920's. In 1923, Hermann Oberth published the important work *The Rocket Into Interplanetary Space.* Starting on an amateur basis, the German effort eventually secured government support and during World War II brought forth the buzz-bomb (air breathing jet) and the V–2 missile (a true rocket). The V–2 marked a tremendous advance in rocket technology and clearly established the possibility of future space flight. Foremost among German scientists was Wernher von Braun, now a citizen of the United States, who heads NASA's Marshall Space Flight Center.

Since World War II, rocket engineering has advanced rapidly. With greatly improved launching vehicles, both the Soviet Union and the United States have been able to place satellites in orbit above the earth and send instrumented packages to the Moon and beyond.

Our space industry was born out of this Nation's supremacy in the aircraft industry. From the Wright brothers' first attempts with gasoline engines and propeller-driven aircraft to today's modern jets, this Nation has excelled in aircraft production and in air transportation.

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The Government has often been the sponsor of much of the aircraft technology because of defense purposes. Now rocket-powered and nuclear-powered spacecraft concepts are blending with the space exploration vehicle to change an entire industrial concept.

Competition, the impetus of progress, has played a most important part. Competition with other nations, competition among manufacturers and among the military has done much to advance space technology. The U.S. Air Force in cooperation with civilian resources has developed new supersonic vehicles, new navigational capabilities, and new airlift capabilities which are coveted then adopted by the civilian aircraft industry.

As you become more and more a part of the space age you should also become aware of its extensive possibilities. Each new discovery opens new areas for research and further development, creating additional careers in space science.

The cost of space research and development can be justified in many ways. The capital investment of the corporations has increased. An increasing demand for new skills in newly developed career fields in space has given these jobs prestige. This represents new investment.

Automation has increased the need for highly skilled individuals. For every laborious task that automated devices replace, a host of new developments result. New production capabilities made possible by automation increases the potential standard of living, which in turn makes the use of leisure time an important matter of consideration. Automation makes possible a precision that can be programed and costed. It may also cause unemployment among those whose education, training, and experience have been neglected or whose talents and aptitudes have been misdirected. Choosing a career in an expanding technological field, then, becomes more than just the achievement of greater socio-economic rewards—it has social and personal implications.

The major agencies of government and industry have recognized the loss of underdeveloped labor and its economic impact and are devoting more and more effort in the education and training of their employees. Much of this effort at a higher level is directed to the Nation's universities through grants, research contracts, scholarships, and similar incentives. At another level, it is directed toward retraining and transfer of skills.

The problem, then, becomes educational. One must develop his capabilities to meet the challenge of space. He must keep up with the exploding developments in space science and technology and at the same time contribute to the preparation of new generations for a future that cannot be visualized—one that requires greater knowledge and ability than is now known. He must prepare!

Space technology is today the most complicated yet exacting new area of development and the most rewarding. It is becoming the largest and most important industry employing over a million people in 1964 with an annual payroll of billions of dollars. All the inventions and advancement of mankind are dwarfed in size when compared to the future potential in the development of space. Your great grandchildren may refer to today's effort in space development as the beginning of a Space Revolution even as we refer to the Renaissance or the Industrial Revolution. So there are things that must be done, new changes that have to be made, dreams that have to be dreamed, goals that have to be established—for you and by you!

Electronic computers can be as small as a portable television set or as big as a large living room and cost huge sums of money. Most companies would of course, rent such expensive service. Programers, workers representing a new career will be needed in increasing numbers as computers figure a less expensive way to produce goods and services. One expert estimates that we will need 65,000 programers within the next ten years.

Without electronics the guidance systems of aerospace craft and missiles could not function, nor could our present day society. The transistor and the printed circuit have revolutionized electronic production. The Telestar and Syncom Satellites have introduced new concepts in communication, in transmission; other innovations and discoveries promise to revolutionize the traditional science curriculum.

Breakthroughs in science—new sources of heat, light, energy, power, new synthetics, plastics, new chemicals, and basic materials—require fundamental understanding of the traditional and contemporary content of science, mathematics, and languages. But intellectual initiative, perception, and inventiveness, as well as new and continuous knowledge are also necessary.

WHY ARE WE IN SPACE?

We are in space to gain knowledge. Space provides infinite industrial opportunities. President Lyndon Johnson, former Chairman of the National Aeronautics and Space Council, stated that the whole economy would be enriched by space development; that space will act both as a stimulus and a catalyst in improving standards of living, increasing employment, and adding to our wealth of knowledge. He indicated that soon space science will reach into every home, every business, and the life of every family. President John F. Kennedy said that we are setting sail on a new sea because there is new knowledge to be gained and new rights to be won and that they must be won and used for the progress of all people. He indicated that now is the time to prepare, to take longer strides—time for a great new enterprise. In a special message on urgent national needs to a Joint Session of Congress, he stated that this Nation should commit itself this decade to achieving the goal of landing a man on the moon and returning him safely to the earth. He stated that no single space project would be more impressive to mankind or more important for the long-range exploration of space. He concluded that none would be so difficult or expensive to accomplish.[2] Wernher von Braun says that he believes space exploration is the wisest investment America has made—not because of his leadership role, but because it is the kind of stimulus the economy needs. He indicated that the real pay-off did not lie in mining the moon but enriching our economy and our sciences with new methods, new knowledge, new procedures, and advanced technology. Dr. Edward Teller, one of America's leading scientists has said that before the century is over we will have explored our entire planetary system reasonably well; we will have found out how to influence weather, to make proper use of the ocean, to cure cancer and heart disease, and to produce materials to order, synthetically. He states that a scientific career is more than a duty to society—that it is an opportunity, unequalled.[3] James E. Webb, Administrator of the National Aeronautics and Space Administration says that pre-eminence in space exploration will insure a place of leadership for the United States; that the stimulus of new knowledge will return practical dividends in the form of new products and techniques of great value to industry, the professions, and everyday life. The scientific importance of exploring space may hold the answers as to how the solar system was created, where life began, and how planets develop and change. History has repeatedly shown, Mr. Webb declares, that the results of investigations in basic science are eventually for mans' betterment.[4] The NASA Administrator also indicated that science and technology are rightly regarded by the world's peoples as the keys to economic progress and military strength. Colonel John Glenn, United States Marine Corps, retired, first American astronaut to orbit the earth said that, "The clock is operating—we're underway. All systems are 'Go'."

To sum up, we are in space because we *must be,* intellectually, morally, scientifically, militarily, and economically. The fact that the United States entered into the frontiers of space exploration is of paramount importance to you, the high school student. By your careful consideration and deliberate preparation you can choose a lifetime career that will be rewarding by every measure of your desire.

[2] *The G E Forum,* July-September, 1962, Vol. V, No. 3, p. 7.

[3] *Career Opportunities,* New York Life Insurance Company, 1963, p. 352.

[4] Reprint: *Missiles/Rockets,* November 27, 1961.

A CHECKLIST OF BASIC FACTS ABOUT THE SPACE INDUSTRY

Did you know that:

1. Infinity, as applied to careers in space industry, means subject to no limitation, immeasurable, inconceivable.

2. Estimated U.S. space budget* excluding Defense, for 1965, is over five billion dollars, for 1967 over seven billion, for 1970 over nine billion dollars.
   *includes Atomic Energy Commission, National Science Foundation, and Weather Bureau.

3. Over 85 percent of space dollars goes into private industry.

4. A national objective, clearly defined, universally understandable, is to put man on the moon in this decade.

5. An expenditure of about eight million dollars a day will greatly enhance the technology of this country, creating thousands of new jobs.

6. Exploration of the moon may be just the first step of a planned exploration of celestial bodies in other galaxies.

7. New concepts of miniaturization, management, and precision, will require mastery of fundamental high school and college course work.

8. That a conservative average entry wage in a specialized space career in industry for a person with a master's degree or beyond will be close to $1,000 a month.

9. That now is the time to plan and prepare for a career in space science, engineering, and technology.

HELPFUL REFERENCES

1001 Questions Answered About Space, by Clarke Newlon. New York: Dodd, Mead & Company, 1964, 338 pp.

The book is organized so that the reader may prepare himself for understanding of the latter part of the book by reading the first part. Some knowledge of physics and mathematics is necessary for understanding of the techniques of space exploration, but history, space programs, and other topics are easily understood.

One, Two, Three and the Moon. NASA EP-7, Washington, D.C.: U.S. Government Printing Office, (Revised 6/63), 28 pp.

A step-by-step report of America's manned space flight program leading to fulfillment of a manned expedition to the moon by 1970.

One, Two, Three . . . Infinity, by George Gamow. New York: The Viking Press, 1961, 335 pp.

This book could serve to give the reader a feeling for and general knowledge of the entire area subject to scientific inquiry. Some mathematics and science knowledge would undoubtedly be helpful in gaining all that is to be gained from the book.

The Space Guidebook, by William J. Weiser. New York: Coward-McCann, Inc., 1963, 311 pp.

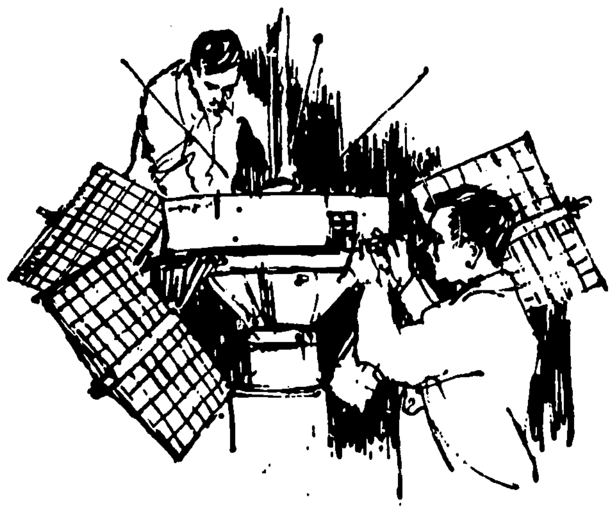
The book is written so that a high school student with an average background in science and mathematics could benefit from it. Ideas of outstanding scientists and scientific knowledge are simplified.

Space, The New Frontier. NASA EP-6, Washington, D.C.: U.S. Government Printing Office, (Revised 11/64), 72 pp.

A comprehensive report of America's unmanned and manned space programs. Includes a glossary of frequently used space terms.

CHAPTER 3

CONSIDERING AN OCCUPATION IN THE SPACE INDUSTRY



Have you noticed that occupational choice requires a great amount of learning?

Have you noticed that occupational choice takes time?

How much time have you spent on your choice so far?

Do you think the time spent on your choice has been sufficient, so you can say, "I have been fair to my future"?

Now that you have been alerted to the possibility of a career in the space industry and have begun to learn more about the industry itself, it is time to get a perspective on space careers. This may be done by first thinking about an overview of all occupations, and next by becoming acquainted with the many different occupational groups within the space industry. One of these may be your choice of career fields.

If you are thinking about selecting a career in space, it may be helpful for you to make a mental note of those occupational categories that are most attractive to you. Since there are so many different occupations within the space industry, perhaps it will be easiest to start by selecting from broad occupational groups or families, such as Life Science, or Fluid and Flight Mechanics, or other groups that attract you. Once you have made a selection of groups, you may finally proceed to the occupational specialties within those groups, and again find those most interesting to you. The check list at the close of this chapter should be of further help to you in becoming acquainted with occupations and indicating your preference for occupational areas and groups. It can help you also in narrowing your choice of career fields.

Naturally, once you have determined which occupational group(s) is most attractive to you, you would need to learn about its educational and experience requirements, and about the responsibilities of the job in order to determine your qualifications to perform the job. This will be discussed more fully in later chapters, but should be present in your mind to some extent as you consider the possibilities.

THE GENERAL AREAS OF ALL OCCUPATIONS

Do you realize that there are thousands of occupations? Have you seen the book, *Dictionary of Occupational Titles* [1] that is organized into nine categories into which all occupations can be placed?

Think for a moment of all the people you know who are part of the working world. With the help of the *Dictionary of Occupational Titles* classification system, this variety of occupations can be grouped into areas, thus facilitating your quest of selecting a career. As you read and think about the following classifications perhaps you will place in their proper categories those jobs with which you are familiar. You may also be thinking about those areas most attractive to you.

I. Professional—Professional occupations often require training, ranging from four to seven years. Many professions require college, and often licensing examinations are required.

Here are some examples of the professional occupational titles that appear in the *Dictionary of Occupational Titles:* Accountant and auditor, professor and instructor, engineer, teacher, social scientist.

II. Semiprofessional—Semiprofessional occupations usually do not require the study of as much theory. The emphasis is more on knowledge of the technical and practical aspects of the work. Examples of occupational titles included are aviator, designer, draftsman, and photographer.

III. Managerial—Managerial occupations center around supervisory work and/or leadership responsibility. Included are hotel and restaurant manager, buyer and department head, advertising agent, manager and superintendent of buildings, and railroad conductor.

IV. Clerical—Occupations in this category consist mainly of routine type work; however, speed and accuracy are very important in the skilled positions. Training in typing, shorthand, and frequently, bookkeeping is necessary for jobs of this type. Examples of jobs range from bookkeeper, clerk, and library assistant, to messenger, stenographer, typist, and telephone operator.

V. Sales—There are different types of sales occupations. Retail sales occupations are involved with selling directly, to the consumer; on the other hand, wholesale selling is done to businesses, industries, and stores.

Some typical sales occupational titles are auctioneer, demonstrator, newsboy, sales clerk, and real estate salesman.

VI. Service—Occupations in this category are characterized as work done, or the performance of duties, for another person or other people. The four generally accepted groups included here are:

Domestic:	Occupational examples are day worker, cook, housekeeper.
Personal:	Barber, waiter, doorman, usher.
Protective:	Watchman, fireman, policeman, soldier.
Building service:	Janitor, porter, elevator operator.

VII. Agricultural, Fishery, and Forestry—The occupations in this category have a strong emphasis on outdoor work.

Agriculture:	Jobs included are dairy farmer, landscape gardener, and nurseryman.
Fishery:	Examples are fisherman and oysterman, sponge and seaweed gatherer.
Forestry:	Examples are hunting and trapping guide, hunter and trapper.

VIII. A—Skilled, B—Semiskilled, and C—Unskilled Occupations—This category covers a variety of occupations both in (1) manufacturing and (2) nonmanufacturing industries.

A1. Skilled occupations in manufacturing and related activities include baker, cloth grader, cabinetmaker, bookbinder, and welder.

A2. Skilled occupations in nonmanufacturing include bricklayer, bus driver, lineman, meat cutter, and maintenance mechanic.

B1. Semiskilled occupations in manufacturing and related activities include slicing machine operator, box maker, solderer, and general assembler.

B2. Semiskilled occupations in nonmanufacturing fields include wrecker, chauffeur, parking lot attendant, park caretaker, and automobile mechanic helper.

C1. Unskilled occupations in manufacturing and related activities include candy packer, packing machine feeder, rag sorter, stone feeder, and shopboy.

C2. Unskilled occupations in nonmanufacturing fields include carpenter helper, longshoreman, fuel attendant, park laborer, and stock boy.

You have just completed a very brief presentation designed to give you an overview of all occupations. Were you able to get a tentative idea of which occupational areas may be attractive to you?

It is, of course, obvious to you from what you already know about the space industry, that all of the occupational areas mentioned do not relate to the space industry. Just on the basis of your limited and rapid survey of all the occupational areas, which would you say are the areas most closely related to the space industry? Think just a bit longer; it is rather easy, you say? On the basis of the information provided, what is your conclusion? You think that the majority of the jobs in the space industry are for scientists, engineers, and technicians; and on that basis you select the professional and semiprofessional areas as being most closely related since they include the scientists, engineers, and many technicians. You say also that the other areas that are related to a lesser degree are managerial (moderately), clerical (as it is in many fields), skilled occupations (especially certain manufacturing occupations), and semiskilled occupations (again, in certain manufacturing fields). The other areas you do not regard as directly related, but in special areas some relationship may be found. If your thinking followed this line, you have shown a good grasp of the overall picture. At this level of understanding of occupations, you are likely in a good position to think of how you might fit into the space industry.

At this point, more information about space careers would be most helpful; thus, the next section finally focuses on an overview of occupational groups in the space industry. The format for this overview is the NASA Aerospace Technology Specialties Classification Plan.

CLASSIFICATION OF SPACE INDUSTRY OCCUPATIONS

With all the previous emphasis on the rapid changes in the space industry, it is undoubtedly obvious to you that classifying jobs in this industry is quite difficult. New work areas continually emerge, and existing areas change; thus, there is a continued need for review, revision, redefinition, and creation of Aerospace Technology Specialties. The idea behind it all is to describe adequately the scientific and engineering work associated with solving aerospace problems so as to make it possible to select qualified workers to get the job done or the problems solved.

The task of classification in the space industry is also made difficult by the fact that space jobs are often not the most clearly defined jobs, such as may be found in some other industries. In addition, because of the nature of the more complicated problems to be solved in space activities, workers must be qualified in more than one field. This is called interdisciplinary competency. A person who is educated and/or trained as a specialist in one field may be required to study another field as well. As a consequence, he will be able to attack the interdisciplinary problems he meets. Examples are meteorologists who study astronomy, or lubrication specialists who study propulsion systems.

At this point, we will focus on the NASA Aerospace Technology Groups.

AEROSPACE TECHNOLOGY OCCUPATIONS

There are ten groups of occupations in aerospace technology. Each group includes occupations in which there are scientists, engineers, and technologists. Whether you should elect to enter an occupation in one of the groups as a scientist, an engineer, or a technologist would depend on your education, training, experience, and level of competency.

1. Space Sciences Group

This group includes a wide range of jobs which extend from work with theory about space to development and use of methods and equipment to get information about space; from research and study of space phenomena to experimentation in space using sounding rockets and other probes; it also includes analyses of information gathered about space.

The subjects that are dealt with in space sciences include the composition and the structure of planetary atmospheres and interplanetary plasma; the sources, natures, and effects of planetary and solar ionospheres; the sources, natures, and effects of magnetic, gravitational, and electric fields, and of energetic particles existing in space; the study of extrasolar celestial bodies and phenomena; the origin and evolution of stars and planets, and their elements and constituents; the study of moons, planets, asteroids, and interplanetary media and their changes; the study of the physical properties of meteoric materials or dust particles in space media. You may have begun studies in these areas in your general science, space science, or astronomy courses.

Another important subject area is related to the sun; these studies involve determination and analysis of phenomena of the sun by investigations of electromagnetic solar radiation. Information concerning solar phenomena that can be viewed within our country are reported in newspapers, science classes, and science magazines. All of the information obtained from the study of these subjects contributes to the solution of space exploration problems.

II. LIFE SCIENCES GROUP

This group includes jobs for scientists, engineers, and technologists and pertains to the study of life and the maintenance of the lives of the space travelers.

Some of the jobs involve planning, development, or evolution of systems or techniques for actual or simulated aerospace flights or extraterrestial explorations. We have mentioned the necessity of many tests, experiments, and simulated runs related to space flight. Complicated simulated approaches to landing on the moon are being run already by astronauts who may fly the Apollo mission. This is an example of planning ahead (lead time)—astronauts flying the simulated mission to prepare far in advance of the flight time.

Other jobs are related to the study of physiological stress factors during space flight. This would also include the study of the physiological responses, adaptations, and tolerance limits of the space travelers. The space equipment must be designed to provide man with an environment to meet his needs. One prominent question is just how much of man's environment must be taken with him into space. So far, he has taken the bare minimum, but he has not stayed in space long. If he stays longer, he will have to take more of his environment into space.

Another major group of problems dealt with by people in other jobs in this group concerns aerospace radiation phenomena and its effects on living organisms. The problems related to satisfactory shielding necessary for the maintenance of life is studied, and means of solving this problem are dealt with by persons holding jobs in this group.

Still other jobs in this group relate to problems of psychology, such as the responses and performance of the space traveler under phyiscal and psychological stresses. The problems related to manned operation and control of vehicles and flight or ground equipment involving instrument displays, manual controls, and communications, are also dealt with by persons classified in this group. You have no doubt heard of the space flight problems of isolation, monotony, sensory deprivation, tensions, and conflicts—these are important considerations for this occupational group.

Another group of problems pertinent to this group is the development of replenishable, partially regenerative, and regenerative life-support systems. These problems must be solved to make possible extended aerospace flights, space voyages, and planetary explorations.

III. FLUID AND FLIGHT MECHANICS GROUP

This group includes jobs for scientists, engineers, and technologists who study and perfect space flight vehicles. They deal with a wide range of problems related to space flight. Some jobs are oriented toward the solution of the problems of spacecraft in the areas of aerodynamically (air motion) and mechanically induced loads, vibrations, aero-elasticity, noise, internal flow, fluid flows,heat transfer, and skin friction. Several of these problem areas are connected with certain aspects of our space program. You probably have heard about the vibration problems with the Titan missile. You, no doubt, remember the heat shield burn-up when John Glenn's capsule re-entered the atmosphere. This is a problem related to skin friction. Other jobs in this group are concerned with solving problems related to mathematical calculation and expression of flight paths, ranges and orbits, space rendezvous, and hard and soft landings. Another category of jobs emphasizes the investigation of questions involving control, guidance, and navigation of space vehicles both in the atmosphere and in space. Control of spacecraft is an extremely critical problem. Small errors made early in flight and uncorrected become errors of hundreds or thousands of miles later in flight. Therefore, early detection and correction of errors in space flight are absolutely necessary if success is to be achieved. Thus, other jobs in this group also pertain to determining the best flight paths, tracking, determining errors in orbits or trajectory, and calculating the life expectancy for space vehicles.

The following topics give you a better understanding of other problems confronting workers in this category:

1. Study of the flow of fluids associated with planetary atmosphere and in space.
2. Studies of ionized gases and plasma under the action of magnetic fields.
3. Study of structures, mechanical systems, structural components, and payloads of space vehicles in different environments.
4. Study of the effects of noise in the design and operation of aircraft, missiles, and space vehicles.
5. Study of convective heating variables affecting the transfer of heat in bodies.
6. Study of aerodynamic lift, drag, and pitching.
7. Study of atmospheric characteristics that affect the design and operation of aircraft, missiles, and space vehicles.

IV. MATERIALS AND STRUCTURES GROUP

Workers (scientists, engineers, and technologists) in this group focus their energies on the solution of problems related to the materials (metals, plastics, ceramics) and the structure used in spacecraft, aircraft, and launch vehicles. Related studies cover a wide variety of concerns, such as problems connected with:

1. High and low temperatures, erosion of materials.
2. Properties and characteristics of materials and their effectiveness under various conditions.
3. Techniques of fabricating the materials and methods for applying the material information in aerospace structures.
4. Molecular and atomic structure, crystal structures, structures and plastic deformation of materials used in spacecraft.
5. Research and development of plastics, adhesives, and other organic materials and their use in aerospace vehicles.
6. Thermal control, insulation, corrosion protection, and tailored optical properties as these areas relate to aerospace craft.
7. Friction and lubrication peculiar to aerospace vehicles.
8. Extreme temperature environments associated with hypersonic flight and atmospheric re-entry.
9. Building spacecraft of minimum weight.

V. PROPULSION SYSTEMS GROUP

This group includes jobs related to research, development, design, test, and evaluation of aerospace propulsion systems. The kinds of systems included are liquid, solid, hybrid, electrical, and nuclear. You are acquainted with the Atlas, the Titan, and the Saturn rockets which are liquid fueled rockets. The Minuteman rocket is a well-known solid fuel rocket. Electrical and nuclear powered rockets are now under extensive research. More and more jobs in this group relate to liquid and solid fuel rockets; however, breakthroughs in research in electrical and nuclear rockets could create many new jobs in this field.

Some special problems dealt with by the scientists, engineers, and technicians in this occupational group are:

1. Engine development, thrust vector control, fuel storage, and feed systems.
2. Study of solid propellants, ignitors, gas generation.
3. Studies of generation, containment, and acceleration of plasmas and charged particles.
4. Reactor core physics, neutron studies, shielding experiments, radiation effects on materials.
5. Methods and devices to provide power to the spacecraft.
6. Stability and properties of propellants.
7. Hydrodynamics and pumps and aerodynamics of turbines.

VI. FLIGHT SYSTEMS GROUP

This group includes those jobs that have to do with the flight vehicle and its related systems, e.g., launcher, telemetry, support equipment or a whole flight vehicle including its propulsion, control system, and instrumentation. Workers in this group are concerned with determining the reliability (how long and how well does it perform) of aerospace systems. It is, of course, more important than ever with space equipment that it perform without breakdown, as once a vehicle is in orbit or on an extended voyage, repair or replacement of parts is extremely difficult. Thus, a part failure may cause the mission to fail or abort.

This group of occupations also performs tests of ground systems that support the spacecraft. Here again, failure in these support systems may cause a mission to fail or end prematurely.

This category includes occupations having to do with the manufacture and assembly of unique multistage launch vehicles. This would also involve the evaluation of the vehicles, determining potentials and limitations. The task of workers would also require their constant evaluation of spacecraft manufacturing techniques and methods for efficiency.

Others would be engaged in professional work to establish, maintain, and evaluate quality assurance programs. These quality assurance programs would relate to all aspects of the development of space systems, launch vehicles, spacecraft, and the ground support equipment. These programs would have to be associated with the space equipment production from the design stage to the actual operational stage. This program must insure that every article produced for the spacecraft is of the highest quality. Can you imagine the feelings of an astronaut, about to be launched into space, whose very life depends on the equipment and its functioning? There is little doubt but that his confidence is in the quality assurance program of every manufacturer contributing to his spacecraft.

Workers in this group also attend to the electrical systems of the spacecraft and its support facilities. This involves such subsystems as guidance and control, propulsion, instrumentation, tracking, and separation in multistage vehicles.

Jobs in this category also relate to studies of manned space flights. The studies might include the objectives of the Apollo mission and the means to achieve them.

VII. MEASUREMENT AND INSTRUMENTATION SYSTEMS GROUP

Jobs in this group have to do with equipment and systems for detecting, recording, measuring, or controlling physical conditions and phenomena encountered in aerospace research. When space probes or satellites are put in space they have a particular function and require equipment to help collect information. Different types of sensing devices are used and must be carefully designed to do the job. Workers in this group are involved in the work of perfecting this type of equipment. Other jobs involve standards of measurement of space phenomena, e.g., once the sensors of the spacecraft detect radiation in spac, they must measure it accurately; other jobs involve workers who perfect the automatic controls that are designed to control spacecraft functioning. Jobs also relate to radio equipment used in tracking, command or communications systems, measurement systems, and analytical techniques in spacecraft. This group thus includes jobs related to design, development, performance analysis of space vehicles and/or ground-band antennas to be used with the radio equipment. Others in this group involve work with radar and radar systems for use in tracking of aerospace vehicles.

Other workers in this group spend their time with the problems of aerospace telemetry systems used for transmitting test and scientific data from space vehicles. Workers also devote themselves to communication control techniques that involve coordinating, utilizing, and providing operational control for aerospace communications. You may recall during the TV coverage of the Mercury flights that announcements at times came directly from Mercury control. During a space flight many communication aspects, such as tracking and information processing, must be attended to. Many complicated circuits must be developed and perfected to handle these communicating networks and controls. The workers who operate the equipment must practice to perfect their tasks of receiving, recording, routing, and transmitting communications.

Workers in this group are also involved with research, development, and design of electronic flight and support equipment. This equipment may include synchronization devices and remote programming parts, such as switches, timers, distributors, adapters, connectors, relays, potentiometers, and the like.

VIII. DATA SYSTEMS GROUP

This group includes jobs that have to do with the handling and computing equipment used to process the great amount of data involved with space exploration activities. Workers in this group will be occupied in the application of mathematics, numerical analysis, data reducing, and computing methods focusing on the solution of problems in aerospace research. For example, the discovery of the Van Allen radiation belts was related to the data-processing technique of workers in this group.

Other workers in this group are involved in the application of computer capability to the study of aerospace problems by simulation techniques. In other words, a theoretical model of an aerospace problem is formulated in computer language. The computer may then be operated to apply and/or test out the approach represented by the model without actually building the hardware to solve the aerospace problem. These jobs require computer theory understanding, as well as appreciation of aerospace problems.

Workers in this group also specialize in research, design, development, test, and evaluation of data handling and computing equipment. Closely related are those workers who install, modify, and maintain this type of equipment.

IX. FACILITIES AND OPERATIONS GROUP

Persons engaged in work in this category plan, develop, and design facilities and equipment used in aerospace research. This involves such facilities and equipment as flight vehicle launch and range and tracking facilities, wind tunnels, test stands, space environment chambers, and aerospace simulators and flight trainers.

Workers in this group also focus on aerospace vehicle launching and flight operations. The work involves the planning, development, coordination, and evaluation of activities related to the launching and operation of aerospace vehicles. Workers may also devote themselves to the design and development of special model tooling and equipment for experimental programs in aerospace. Others focus on problems relating to handling gases and liquids involved in aerospace work. Still another group of workers is engaged in the application of electrical techniques, equipment, and systems in aerospace facilities.

Also, some employees are involved in the task of determining the operation and studying the use of the facilities. For example, a wind tunnel may be adapted for use in the test of antenna satellite configurations as well as for shapes of other types of aircraft. This group includes those workers whose tasks are piloting of flight vehicles, such as aircraft and space vehicles. These test pilots would thus be involved in evaluation of the performance of the craft in flight and/or during simulated ground missions. The work also includes quality research and determining requirements of spacecraft in terms of stability and control, pilot presentation needs, and escape systems. Pilots' tolerance and efficiency under various conditions are also studied as part of the work of those in this group. You have probably seen pictures of simulators designed to test man's endurance at different G levels. Such tests provide needed information before actual space flights are made.

X. MANAGEMENT GROUP

This group includes jobs having to do with the management of space projects. Management would involve attention to cost estimates on projects, research necessary to complete projects, production of equipment considerations, also supporting facilities, launch operations, project requirements, negotiations for services at space centers, and questions of policy, money, scheduling, resources, and technology, as well as many other considerations. For example, a major phase in management would be the rescheduling and adjustment in a project after a major breakthrough in technology has been made. If a breakthrough occurred in electrical or nuclear propulsion this could change the Apollo Project and the upper stages in the Saturn vehicle. Management would be instrumental in making decisions about rescheduling.

Workers in this group are also involved in technical management having to do with planning, consulting, advising, evaluating, and administering in aerospace projects and programs. Here the concept of lead time is related as it is throughout aerospace.

If deadlines are to be met and the work to be accomplished to complete a project at a certain time, the management must be superb.

This group also includes tracking station management and management jobs related to all of the other specialties within the space industry.

SURVEY COMPLETED

You have just completed a survey of the occupational groups related to careers in space. The view is through the eyes of NASA and, as you might imagine, private industry would have a somewhat different view. This is because NASA's responsibility cuts across all the areas related to space activity whereas private indus try would specialize on a few of the aspects. For example, an electronics company might specialize in radar equipment, another company may specialize just in the production of nozzles for rocket engines, another company may build radio equipment components and data processing equipment, and another may assist by doing research or development.

Before Going On to More Information

At this point and before moving ahead to pathways and requirements in space careers, you may wish to complete the following checklist. The list includes the occupational areas plus examples of all occupations, and the occupational groups, plus examples, relating to space careers. You might just read through and on the basis of what you know about yourself and occupations check the ones you want to explore further.

Occupation Checklist—Check Your Preferences

Occupational Areas—Related to all occupations

______Professional occupations

Examples:

______Accountant
______Actor and actress
______Author
______Chemist
______Dentist
______Engineer—metallurgical
______Engineer—chemical
______Engineer—civil
______Engineer—electrical
______Engineer—industrial
______Engineer—mechanical
______Engineer—mining
______Lawyer

_____Musician
_____Pharmacist
_____Physician
_____Teacher
_____Trained nurse
_____Veterinarian
_____Natural scientist
_____Social scientist

_____Semiprofessional occupations

Examples:

_____Aviator
_____Decorator
_____Dancer
_____Designer
_____Draftsman
_____Laboratory technician
_____Athlete
_____Radio operator
_____Showman
_____Surveyor
_____Technician
_____Photographer

_____Managerial

Examples:

_____Hotel and restaurant manager
_____Wholesale manager
_____Buyer
_____Credit man
_____Ship captain
_____Purchasing agent
_____Railroad conductor
_____Inspector

_____Clerical

Examples:

_____Bookkeeper
_____Clerk
_____Collector, bills and accounts
_____Telegraph messenger
_____Mail carrier
_____Secretary
_____Technical clerk
_____Stenographer and typist
_____Statistical clerk
_____Stock clerk
_____Telegraph operator

_____Sales

Examples:

_____Auctioneer
_____Salesman, insurance
_____Newsboy
_____Sales clerk
_____Salesperson
_____Huckster

_____Service occupations

Examples:

_____Housekeeper
_____Maid
_____Cook
_____Ship steward
_____Barber
_____Doorman
_____Usher
_____Watchman
_____Policeman
_____Soldier

_____Agricultural, Fishery, Forestry

Examples:

_____Cotton farmer
_____Dairy farmer
_____Farm hand, general
_____Fisherman
_____Hunter and trapper
_____Truck farmer
_____Farm mechanic

_____Skilled, Semiskilled, and Unskilled

Examples:

_____Miller
_____Weaver
_____Tailor
_____Cabinetmaker
_____Upholsterer
_____Photographer
_____Jeweler
_____Engraver
_____Electricians
_____Aircraft designer
_____Optician
_____Carpenter
_____Plasterer
_____Longshoreman
_____Meatcutter
_____Machinist
_____Tool maker
_____Foundryman
_____Welder
_____Photographic processing occupations
_____Oiler of machinery
_____Mechanic and repairman
_____Tool dresser

When you use the previous checklist to indicate your career choice preferences, it should be on the basis of the job title and your acquaintance with the duties of those who have such jobs.

When you use the following checklist type you will note a difference. In this checklist you focus on the content and activities of the job first. You then select your preferences on that basis and the job title comes next. This approach is logical because in dealing with space careers, the jobs cut across so many fields and are so new and changing that in many cases they are not clearly defined.

OCCUPATIONAL GROUPS—RELATED TO SPACE CAREERS

________Space Sciences Group
- Examples:
  - ________Physicist
  - ________Astronomer
  - ________Mathematician
  - ________Meteorologist
  - ________Astrophysicist
  - ________Engineers, various types

________Life Sciences Group
- Examples:
  - ________Biologist
  - ________Psychologist
  - ________Technician
  - ________Physiologist
  - ________Physicist
  - ________Engineer, aerospace
  - ________Ecologist
  - ________Geneticist
  - ________Other scientists, engineers, and technicians

________Fluid and Flight Mechanics Group
- Examples:
  - ________Aerospace engineer
  - ________Physicist
  - ________Other scientists, engineers, and technicians

________Materials and Structures Group
- Examples·
  - ________Aerospace engineer
  - ________Other scientists, engineers, and technicians

________Propulsion Systems Group
- Examples:
  - ________Aerospace engineer
  - ________Physicist
  - ________Other scientists, engineers, and technicians

________Flight Systems Group
- Examples:
  - ________Aerospace engineer
  - ________Electrical engineer
  - ________Manned space flight systems engineer
  - ________Other scientists, engineers, and technicians

________Measurement and Instrumentation Systems Group
- Examples:
  - ________Physicist
  - ________Electronic engineer
  - ________Other engineers, scientists, and technicians

________Data Systems Group
- Examples:
  - ________Mathematician
  - ________Electronic engineer
  - ________Other engineers, scientists, and technicians

________Facilities and Operations Group
- Examples:
  - ________Mechanical engineer
  - ________Electrical engineer
  - ________Aerospace engineer and pilot
  - ________Other engineers, scientists, and technicians

________Management Group
- Examples:
  - ________Various scientists
  - ________Engineers
  - ________Various aerospace specialists, technologists, and technicians

Helpful Reference

Careers in Space, by Otto D. Binder. New York: Walker and Company, 1963.

Written for high school students, this book gives a comprehensive coverage of the space industry. Its profiles of major aerospace industries should prove useful for those students planning for careers in the space age.

NASA, Twentieth Century Explorer. NASA Personnel Staff edited in cooperation with the Civil Service Commission, Washington, D.C.: United States Government Printing Office, 1965.

This publication of the Educational Programs and Services Office of the National Aeronautics and Space Administration provides the reader with the latest information on educational qualifications and other requirements for employment by NASA in Career Professional Positions in Aerospace Technology.

NOTES

NOTES

CHAPTER 4

DETERMINE PATHWAYS TO A CAREER IN THE SPACE INDUSTRY

Where does one start to prepare for a lifetime career in the space age?

What sort of preparation should be made in high school for future training?

Where should one go to find out about the qualifications for choosing a career in the space industry?

Can a woman have a career as a space scientist, engineer, or technician?

A VARIETY OF PATHWAYS TO CHOOSE

While you are reading this, new space careers will be born, adding to the complexity of choosing from among rewarding lifetime occupations. There are so many routes for one to take that planning becomes all the more essential. All choices require thorough investigation, deliberate planning, and careful matching of qualifications against opportunities. What pathways you determine should be based on fact, not fancy. Your choice should be built on an honest self-appraisal of your interests, aptitudes, abilities, and achievements. Your qualifications and ambitions should be realistically related to your goals. Your planning should be thorough and your choice based on all the factors.

One cannot choose what one does not know. One may stumble into an occupation by sheer luck. The wise choice of an occupation requires accurate information about what occupations are available, what they require, and what they offer and the trends for the future.

STAY IN SCHOOL

To choose properly one must prepare, and the great principle of preparation is learning. To learn one must become a good student, not just a pupil. A good student must have good study habits. One must *stay in school*—for perhaps the next eight to ten years—high school, college, graduate school, technical school, flying school, specialized training, test and research training, workshops, seminars! Yes, choosing a specific career in space science, engineering, or technology is choosing a lifetime of further study.

Major Robert White, an X-15 pilot and astronaut, declares that the stairway to the stars is built of school books and there is no conceivable shortcut. The basic principles of spacemanship are being taught, now, in the classroom. He concludes that there is no such thing as too much knowledge and that one never knows what a young man or woman will need or find useful for the hard climb to a top-level job in the space industry.

Some basic steps must be taken in planning. The scientific method mentioned in the first chapter indicated an appropriate approach to solving complex career choice problems. The gaining of information and ideas about a future career should begin at home and in the elementary grades at school.

ELEMENTARY PREPARATION

Your inquisitive younger brothers or sisters will spend a large part of their lives working in the twenty-first century. Many unnoticed vocational ideas applicable to space jobs are developing within the classroom and neighborhood; they should be explored and developed. Activity in early years that helps develop creativity, inventiveness, inquisitiveness, and orginality could be nurtured more by parents, teachers, and others. There are space career implications in art, music, language, in numbers, geography, health, certainly in reading. This is the place to build the foundations of research—to form study habits. Role-playing, or acting out the requirements of a job, for example, may develop new insight, contribute to personality traits that can be channeled into productive ability. Space age role playing, a youth activity, would introduce new important concepts that could be further developed by teachers and parents. Field trips to automated electronic or aircraft industries, or a visit from an airline jet pilot or engineer, provide students with first-hand information needed for forming realistic career concepts. Study habits at home and at school and teaching skills can be made more meaningful if they are enriched by space adventures. Films at school, television at home, and other media could be selected to keep the channels open for space-career information. The pathways develop at an early age. They begin to branch out in junior high school and they divide in high school and college.

EXPLORING INTERESTS AND APTITUDES IN JUNIOR HIGH SCHOOL

Guidance and counseling services can help youth discover their aptitudes, interests, skills, talents, and experiences and turn them into lifetime potentials. Science literature, including science fiction, can do much to indicate to the young teenager that their school, their program, and their teacher are not antiquated. This is the age to acquire and test knowledge of fundamentals, to review and to fortify the basic content of arithmetic, grammar, geography, study habits, and health.

This is the time to read of success, of discovery, of space adventures and activities—a time for science fiction and fact.

Since the space race began, the American people may have become more and more convinced that the strength and destiny of the Nation depends on its educational system. The people look to the schools, the teachers, and the students for an expression of progress. College students who lack scientific fundamentals may find themselves out of step in the present nationwide trend. Their knowledge of the space age should be developed from junior high school through college into graduate school. A space-age vocabulary, then, is a potential building block, a starting point, to determining a pathway to a career in space. Vocabulary building should be an important, deliberate habit in the daily class activity and study habits of the junior high school student. Every new word may serve him or her well in the future. One must know before one may choose—and the junior high school is the place to get to learn about oneself, about the world of work, and the pathways, through high school, into this exciting electronic world of space activity.

CHOOSING A TENTATIVE ROUTE THROUGH HIGH SCHOOL

After having started your preparation in grade school and making realistic adjustments in junior high school, your pathway to a space career is already beginning to present alternate routes. Various paths through high school now become a consideration. Should you choose a vocational and technical course? Should you take a business course? Should you participate in distributive educational programs to learn merchandising, purchasing, selling, or some other domestic or commercial preparation? Or should you take chemistry, foreign language, geometry, physics, and other college preparatory courses? Without a goal in mind and careful realistic considerations of your qualifications and capabilities, your pathway may become a barricade.

It is always best to have an alternate plan. As you plan your career, it is best to prepare for emergencies, such as changes in economic or social conditions. For example, if you plan to go to college keep in mind that sometimes military obligations, or marriage, or even tragedy may interfere with these plans. It may be necessary to take some other route or pursue some alternate goal. Basic courses in typing, speech, salesmanship, and bookkeeping, often come in handy.

Engineering and scientific professional positions require greater preparation in high school, college, and beyond. Even though your intentions may be for a professional occupation—an engineer, a scientist, a research technician—you may be forced by circumstances to a different goal. Recent statistics collected from Ohio schools indicate that only fourteen out of one hundred boys and girls who enter the first grade graduate from college. It is imperative, then, that one equip himself with practical know-how that will insure an adequate standard of living. For example, this may be found in the space-age technologists' skills.

Colleges and universities graduate young men and women who are somewhat prepared for industry, graduate, or professional work, but many of them lack imagination, creativity, and expression. Your high school preparation, particularly if you plan a career in space science or engineering, would be incomplete if you lack high schools' communicative skills. A mastery of the English language, grammar, speech, and then a second or third language is most necessary. The shrinking world and future international relations demand that professionals be bilingual or multilingual. High school courses in mechanical drawing, economics, civics, and geography are also needed as well as language skills. To prepare for a space career dealing with lunar exploration, automation, nuclear power, solar energy, and other new concepts, college preparation must include physics, biology, chemistry, and other sciences including basic and advanced mathematics. Your ability to think logically and express yourself clearly will become increasingly important in establishing yourself in college or on the job.

There is nothing like practical experience to determine a career choice. Part-time work in a type of industry that is similar to your tentative career goal would be most desirable. Whenever possible, students should visit space industrial activities and observe and ask questions concerning the pattern of work and the feelings of the employees.

BUSINESS PREPARATION IN SCHOOL IS IMPORTANT

Management and sales development often become the careers of those who succeed in technical or professional occupations. Psychological skills, personnel management, business management, law, public relations, all should be considered in your vocational development. Data processing, computer programing, and automation should also concern you. Perhaps some of this could be studied in vocational, technical, or distributive education courses within your schools.

Most scientists are graduates of engineering programs. Project managers at space flight and research centers are usually engineers who can speak the language of the technician and also of the scientist. Many technologists and skilled technicians are graduates of pre-engineering or engineering programs. For the engineering student a typical high school preparation might be:

High School Subjects	Units
English	4
History and Social Studies	2
Algebra	2
Plane geometry	1
Solid geometry	½
Trigonometry	½
Physics	1
Chemistry	1
Other academic subjects	5*
	17

*Foreign languages, mechanical drawing, economics, typing, and similar courses.

Some high school students manage to pick up extra credits in summer school, evening school, trade school, or at a junior college. Often would-be engineering students are able to get introductory college courses or advanced courses while still in high school. These include such courses as calculus, aviation, design, slide rule, and foreign languages.

The specific preparation for an engineering career, for scientific concentration, or for technological fields will vary with the field of interest. Preparation narrows down as the student proceeds through college or technical school. In general, pre-engineering courses are the first step. The student desiring to be a scientist may narrow his choices and be involved in more theory, measurement, and research. The engineer may follow the same pattern but cover more area—more management, more operational details concerning other engineering and technical areas. The technician concentrates on getting a specific job accomplished as far as production, installation, maintenance, and repair. The engineering area bridges the gap between the purely theoretical areas and the realistic technical operations.

Those who enter into technical training and excel in that area can be assured of high salaries, continued employment, and expanding opportunities for advancement. Many of the technical schools are now granting degrees based on mastery of industrial knowledge and skills. Most graduates of these schools meet state requirements or the requirements of the union for licensing, certification, or permission to practice their particular skill.

VOCATIONAL EXPERIENCE IS HELPFUL IN MAKING CAREER CHOICES

The need for vocational education cannot be met entirely by the schools. Work experience is necessary. Some students as well as adults participate in community-sponsored work projects, take courses to learn a trade from correspondence schools, and teach themselves a rewarding vocation. The Veterans Administration and many state employment offices provide testing and counseling services to help in training and retraining persons whose present skills or talents are not in demand. A student should find out early through testing what interests, aptitudes, abilities, and skills he possesses. A test battery profile at various ages could indicate vocational areas and career families in which one might excel. It could also reveal areas to avoid. With occasional test evaluations and by constantly striving to improve one's self, a student could be relatively confident as to his potential success in a selected career field.

There are many vocational opportunities that go unnoticed. Many of these opportunities are available through your local employment office. The U.S. Department of Labor and its Bureau of Labor Statistics coordinates labor information and statistics with state employment offices. It publishes the *Dictionary of Occupational Titles*—the "bible" of occupational classification. State employment offices usually have professionally trained employment counselors, testing facilities, and current unbiased information regarding labor conditions in the area. They are in the business of finding suitable jobs for qualified people. Public libraries, university and college libraries, counseling centers, the Veterans Administration, the YMCA and YWCA, the American Legion, B'nai B'rith, and other similar agencies also provide occupational information, literature, and service. The *Occupational Outlook Handbook* and *Occupational Outlook Quarterly*, published by the Department of Labor, can usually be found in any school guidance office or library. They provide the latest occupational information available nationally. Occupational information has become an area that many publishing concerns and psychological agencies have recently turned to for profit and growth. Many such agencies provide psychological tests, programed and other texts, occupational briefs, occupational monographs, fact sheets, job descriptions, career indexes, and related vocational guidance material.

The National Vocational Guidance Association (NVGA) publishes a *Bibliography of Current Occupational Literature* (1963) which lists many items that are published. It also provides a standard or yardstick for evaluating occupational information.

The NVGA standards for judging occupational literature include the consideration of the history of the occupation, the duties and nature of the work, the current need for workers, trends and outlook, the qualifications for the job, the preparation necessary including the general education, and the special training or experience required. The standards also give consideration to the methods of entering and advancing, other related occupations, what earnings would be, the wage range and other benefits as well as the working conditions, the hours, and the hazards—the advantages as well as the disadvantages. In brief, occupational literature should be clear and concise, interesting, understandable, illustrated, easily identifiable with charted specifics, and easily interpreted. Should not you consider each tentative career choice similarly? How do your tentative selections meet such criteria?

Deliberate study of occupational information may lead to earlier decisions and fortify previous choices. There is nothing like seeing for oneself, however. Visits to industrial concerns by class groups or individuals will help one appreciate the work environment and give insight into what the worker is like on the job. Besides tours, it is always helpful to talk to or correspond with persons who are actually doing the type of work that seems to meet your tentative choice.

Career Days and Career Nights, Career Weeks, and Career Clinics are also opportunities to learn about many career interests. These should be related to visits to the campus and perusal of college, university, or technical school catalogs, bulletins, and brochures.

PHYSICAL-PERSONAL CONDITIONING SHOULD NOT BE OVERLOOKED

The physical requirements needed to perform an occupation are important and should be considered when you plan your career. In addition, attention should be given to the health and recreational opportunities. The psychological needs for relaxation, pleasant surroundings and companionship should be considered as well as pressures, deadlines, and other frustrations. Stamina, strength, agility, and contentment go hand-in-hand with vocational choice.

DEVELOP YOUR PERSONALITY—BUILD YOUR CONFIDENCE

A key to success in whatever endeavor you choose lies in your ability to get along with your associates. A pleasant, cheerful attitude may be as valuable as a specialized skill. You may find it necessary to take some psychological and personality tests to discover what things you like and dislike, what frustrates you, and what biases, prejudices, and inhibitions you have. On the more positive side it would be well to evaluate how well you can express your feelings, needs, ideas, and strong points. It would be advantageous to understand what you hold to be of greatest value, of little value, permissible, or intolerable.

The skill and art of winning friends and influencing people should be practiced at home, in school, on the job, and enroute. Personality development is a continuing process and functions when you are relaxing, working, or playing. Pleasant associations and a sense of humor can do much to release the accumulating pressures of modern society.

MILITARY SERVICE—AN OPPORTUNITY FOR LEADERSHIP

Men and women often enter the military service with an idea that they are fulfilling an obligation or that they will have great fun in traveling. Military service is also an opportunity to prepare oneself for a lifetime career in space science, engineering, or technology. The Department of Defense provides the most modern equipment and facilities to perform vital defense missions. Military technical schools offer courses that extend from basic to the professional level in such areas as electronics, meteorology and weather, weapons systems, aircraft, and missile maintenance.

Military occupational specialties are systemized and directly related to civilian classifications and titles. Thousands of veterans have been introduced to their present skills because of their military training. Following technical education while in service, young men and women perform on the job under skilled and professional supervisors at installations such as Patrick Air Force Base (Cape Kennedy), Edwards Air Force Base (X–15 testing), Langley Air Force Base, Virginia, and dozens of other major research, development, testing, or missile operational bases. The management and operations activities within the military are almost identical with those of large space industry agencies. An off-duty educational program is available at nearly every military installation, usually providing high school courses, some technical courses, business courses, college courses, graduate courses, even specialized and professional training. Much of the cost of this extra education is borne directly or indirectly by the Department of Defense. Thousands of servicemen have received their bachelor's or master's degrees from a nearby civilian university or college while receiving full pay and allowances as an active member of the Department of Defense.

Hundreds of servicemen and women are granted permission to attend universities and complete their college work under a program known as "Operation Bootstrap." Still hundreds of others are sent to universities for several semesters to receive professional training and advanced graduate degrees under the Armed Forces Institute of Technology program. Correspondence, extension, and self-teaching courses under the sponsorship of the United States Armed Forces Institute are also available to service personnel.

Perhaps more important than the classroom work gained in civilian or military schools is the leadership and experience gained from performing on the job. The military is such a large industry that science, technology, management, and logistics become matters of direct concern to the taxpayer. A serviceman has a golden opportunity to study the functions of big business, space industry, and scientific development and at the same time serve his country.

The opportunities to study in foreign countries, and to learn their languages, customs, procedures, to assimilate their culture, and to travel can also enhance your preparation for a career in space development. Many persons in the military manage to save money while using their military service to gain valuable education, training, and experience.

AFTER HIGH SCHOOL– DOORWAYS TO THE TOP

Plans for your future and alternate plans should be discussed with your high school guidance counselor, your parents, and friends. You have this responsibility. Plans should, if possible, include a good four-year accredited college or a nearby junior college that can provide transferable credits. Choose your university or college carefully, based on all the information you can gather. Check the advantages and disadvantages of each school against your tentative or long-range plans and know what you are seeking before you enroll. Start gathering your data when you enter high school and by the end of your junior year know what your choices are. Costs of tuition, room and board, textbooks, fees, student activities, and clothing are constantly rising and as such should be deliberately considered. Someone has to pay the bills, so each choice should be carefully measured in terms of money, time, difficulty, and probable outcome. Often compromises or alternate choices must be made.

Entrance requirements and procedures also change. Most schools are becoming more selective and require pre-enrollment information months in advance of the beginning of the school term. The grade point average and the results of college entrance or placement tests are the major determining factors in student selection and processing for admission. A grade point average near or below a 2.00 (C) may eliminate you from future consideration in the school of your choice. It may also influence or indicate the academic difficulty you will have pursuing a particular course of study that you have selected. Your entrance examinations and other psychological testing can give you an indication of your actual aptitudes, abilities, and intelligence that you must factually consider.

Even if you have no worries in academic preparation, you will have a major concern in choosing your course work. Be certain that the curriculum you choose has real value in relation to the goals that you have selected. From the many choices of courses you must select those that lead to a goal, that provide a platform for another area of specialization. Your guidance counselor, your parents, and your friends can help explain these relationships but it is your responsibility to understand why each building block is of value to you based on your self appraisal.

Scholarships are available for many. For those in need, college loans, and sometimes grants are available for those whose academic record has been noteworthy. A study of available scholarships, grants, loans, fellowships, and assistantships is necessary. Several recent books on scholarships are available in many high school guidance counselor's offices or in libraries. This information is constantly changing and often requires much advance planning and correspondence to insure support for a particular course, semester, or college. A thorough study of available scholarships that fit your career plans should be made while you are still in school.

MILITARY ACADEMY—A ROUTE TO A PROFESSIONAL CAREER

A military academy may fulfill career ambitions for young men with outstanding leadership abilities, motivation, and better than average physical and academic ability. Certainly graduates from military academies will be leaders in the development of space missiles and nuclear management. Academic preparation in academies in the engineering and scientific areas is equal to that available in the Nation's largest and most expensive universities. Here also are the built-in advantages of practical experience in the operation of missiles, rockets, and spacecraft. As a professionally trained, scientifically oriented student, the potential for future space research and leadership is limitless.

There are hundreds of colleges and universities that can adequately prepare a *student* for an entry position in the space industry. The school that *you* choose, should, however, offer special advantages and opportunities related to your particular needs, special qualifications, and personal goals. Similarly, your entry occupation should provide an opportunity to continue your academic and specialized education either on the job by industry sponsored training or by evening courses at nearby colleges or universities.

ROUTES FOR THE COLLEGE GRADUATE—PROFESSIONALISM

Graduate training beyond the bachelor's degree is absolutely essential for the would-be professional. The baccalaureate degree is regarded as the minimum requirement for starting a lifetime career in science or engineering. Graduate study, then, becomes a must. The best time for many students to do graduate study is following graduation from a four- or five-year college. Ideally one should continue through the master's degree with few interruptions except for travel or to engage in industrial research. One should consolidate all experience and training as one prepares for a doctorate. This is particularly true for the student scientist, the research-oriented student, and the educator.

Government employment often pays less than industry for a comparable professional or semiprofessional position. However, paid educational opportunities, vacations, and retirement available in government service often overrides the initial higher salaries available in private industry. The employees of the National Aeronautics and Space Administration as well as the employees of the Department of Health, Education, and Welfare, the Department of Defense, and the Atomic Energy Commission are career civil service employees.

Perhaps the most direct route to a career in space science, engineering, and technology is graduation from a leading five-year engineering school with well above average marks. Industry and government are eager to hire the college graduate who has specialized yet is able to grasp relationships within engineering and production fields and are able to express themselves clearly in writing and speaking.

Other routes besides colleges, universities, and academies may include some specialized technical schools, foreign schools, or work with highly scientific or specialized research teams. The talented artist, the gifted speaker, the skilled tradesman, the inventor, the highly capable repairman, all have found their way into the aerospace industrial family.

MORE WOMEN WILL BE IN SPACE

Womanpower is a source of supply to help meet the great need for engineering and scientific talent. Women have proven themselves to be skilled technicians, capable engineers, and outstanding scientists. In Russia, 30 percent of the engineers and 75 percent of the doctors are women, compared to a little more than 1 percent of America's engineers who are women, 6 percent who are doctors, and 8 percent who are scientists.

Sex-typing of occupations, or limiting certain jobs to men, is the most expensive thing a society can do, according to Dr. Margaret Mead, Anthropologist for the American Museum of Natural History. Dr. Mead claims that sex-typing in the technical occupations has lost not only the brightest members of the female sex, but half of the top talent. She states that there is also a loss in contemporary values to be gained through the differing approaches of the two sexes to the same problems.

Down through the ages, women have proven their capabilities in many areas in spite of traditional limitations.

There is no longer discriminatory legislation dealing with the hiring of qualified engineers, technicians, or scientists in our government and few restrictions in top industry. Lasting careers for educated and well-trained women are to be found in research, in education, in administration, and in management. Such careers for women are becoming more and more the rule instead of the exception. The distaff side in the space age will have equal opportunity but must be equally qualified professionally or technically.

A CHECKLIST FOR DETERMINING PATHWAYS:

Check *Yes* or *No*

Yes *No*

___ ___ 1. Do you have a definite procedure for studying that is producing desired results in school?

___ ___ 2. Do you actively seek new information and explanations about new developments, new procedures, and new discoveries?

___ ___ 3. Do you discipline yourself to reach tentative goals applying new facts, new words, and new ideas to previous plans?

___ ___ 4. How well have you mastered arithmetic, grammar, geography?

___ ___ 5. Have you talked to your counselor about your interests, your aptitudes, your achievements related to possible careers you might become qualified for?

___ ___ 6. Have you selected a course of study to follow in high school to prepare you for college or a specific area of concentration or technical skill?

___ ___ 7. Have you visited an industry or worked part-time in a job that is related to a career choice?

___ ___ 8. Have you figured the high cost of a college education and its higher rewards and discussed a college program with your counselor, parents, and friends?

___ ___ 9. Do you have stamina, health, and tenacity to continue to prepare for the future in the face of pressures, problems, setbacks, or defeat?

___ ___ 10. Will you really use part of your spare time to study, to investigate, or to prepare yourself for a better position—at home, in the military service, or away?

___ ___ 11. Do you have the personality to gain and hold your friends and to enjoy your daily effort?

___ ___ 12. Have you determined which schools offer what kinds of courses that meet your needs and quali-

Yes No

fications; do you know how much they will cost you in effort, in time, in money?

___ ___ 13. Do you know that a professional career in the space industry requires constant study, retraining, and graduate level education?

___ ___ 14. Did you know that the competition will be keen from other countries and that the best opportunities will go to the best prepared?

___ ___ 15. Did you know that the information services of your school's guidance department can provide you with much information about yourself and the educational and vocational information to succeed in a space career?

Helpful Reference

Carsbie C. Adams and Wernher Von Braun. *Careers in Astronautics and Rocketry.* New York: McGraw-Hill Book Company, Inc., 1962.

This book makes a detailed examination of careers and opportunities in the space industry. The various career fields in the engineering disciplines and in the natural sciences are clearly defined as are recommended courses of training in secondary schools, colleges and universities and government-sponsored programs.

Otto D. Binder. *Careers in Space.* New York: Walker and Company, 1963.

This book offers a most comprehensive guide to job opportunities including what college courses are necessary and which institutions offer them.

The text includes educational requirements financial rewards, recruitment methods, financial data of civilian and government projected programs and lists additional sources of career information including student aid programs.

Henry B. Lent. *Your Place in America's Space Program.* New York: Macmillian Company, 1964.

Written for high school students, this well-illustrated book should add to the mounting literature in the emerging fields of work related to America's space program.

Occupational Outlook Handbook. U.S. Department of Labor, Bureau of Labor Statistics, 1963-1964 (Bulletin No. 1357). Washington, D.C.: U.S. Government Printing Office.

This is a valuable occupational information manual. It provides information on occupations by describing the employment outlook, earning, and working conditions, and where to get additional information.

NOTES

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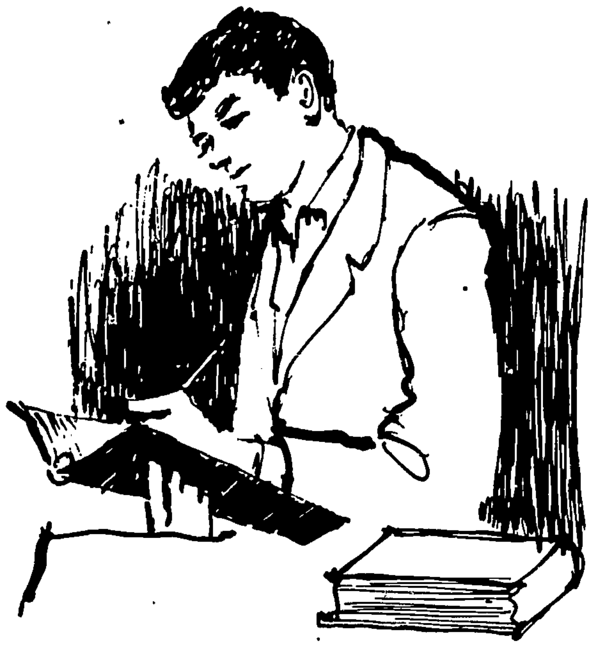
CHAPTER 5

EXPLORE JOB REQUIREMENTS IN THE SPACE INDUSTRY



What has been in the newspaper and on TV about space activities this week?

What particular type of workers in the space industry were prominent in these space activities?

Do you have an idea how these prominent workers became qualified for their jobs?

What types of requirements do the space industry workers have to meet to qualify?

This last question is important for a person who is examining a particular career. You might ask the same question a number of different ways. A common way is to ask, "What will be expected of me in that job?" The answer is, of course, different for each job. Thus for clarity, we return again to the three major categories of workers in the space industry—scientists, engineers, and technicians—and discuss the qualifications expected of each.

EXPECTATIONS FOR SCIENTISTS

In the strict sense of the word, a scientist is thought of as one who does pure research, involving the use of the scientific method and aiming at the extension of knowledge. Pure research means that the scientist actually has no particular goal or end in mind as he starts to do the research. He studies and experiments in pursuit of knowledge for its own sake. Most researchers who fall into this group are associated with laboratories in universities or with certain foundations.

Scientists of this type number less than one-fifth of the total scientific population in the United States. Their work is extremely important, since they provide ideas and theories from which whole new industries and new trends in technology develop and find a foundation. This group includes the Einsteins, Curies, Marconis, and Faradays. These researchers brought forth new knowledge essential in developing theories about atomic energy, radioactivity, electromagnetism, and radiowaves. These developments have spawned a whole new way of life for people in the technologically advanced countries.

Today people of this same intellectual caliber are generating new ideas that will greatly affect future technology. One major influence drives this process on—the curiosity of the scientist. This curiosity causes the scientist to strive on to explore the unknown. The knowledge thus uncovered through his efforts provides the basis for technological progress, and for many new and improved ways of doing things. Progress is also made in improving the means whereby the scientist can do better, more far-reaching research.

Another group of scientists includes more than half of the scientists in the United States. This group is referred to as "applied scientists." Applied scientists are often given a particular problem to solve; however, they maintain the freedom of selecting the approach to solve the problem. Often times, applied scientists are able to push as far along in the solution of problems or into the uncovering of knowledge as pure scientists succeed in doing. Their number is growing rapidly because of increased demands for their services.

The scientist, in order to perform research efficiently, must be able to remember details quickly and easily. He must be alert and observant. He will also want to know the why and the what of things. The scientist's vocabulary will be extensive both in the words he understands and the words he uses. The scientist is capable of learning rapidly with few exposures to the material. He is able to pay attention over an extended period of time. His interests are wide, often with one or two special interests in depth. He is able to reason clearly, and abstract ideas are not difficult for him to understand. Mathematics is one of his stronger subjects, along with science courses. Finally, he possesses and retains good physical and emotional health. These characteristics are important for the person working in scientific endeavors.

EXPECTATIONS FOR ENGINEERS

The engineer, contrasted to the scientist, is different in that he is more the designer of equipment than the one who works for the extension of theory. The engineer does solve problems, but these problems center around the design of equipment (hardware, in space terminology) to test or put into practice an idea or theory generated by scientific research.

The extremely complicated design of spacecraft and the necessity for its being failure-proof have demanded that the space-age engineer become not only a designer, but that he be a researcher as well. The space-age engineer must do studies of his own to learn more about materials and to perfect new designs. Therefore, the engineer must also possess the characteristics of scientists. The emphasis on mathematics is even greater for engineers than for most scientists.

Engineers are, more specifically, charged with the responsibility of the logical pursuit of the application of the physical sciences for the purpose of producing a better product (in space, it would be spacecraft or means of spacecraft production) more efficiently. The engineer is also different from the scientist in that he has a clear goal or end-product in mind. In other words, he designs a piece of equipment for a particular job, and in so doing, he calculates what is theoretically possible to build and how it should operate.

In this designing process, the engineer pays a great deal of attention to his plan. The plan describes how the raw materials are to be transformed into the finished product. The engineer is also concerned with the use of tools required for building the end-product. The engineer has another area of concern. Does the equipment function as it was expected to? If not, the engineer must work out the modifications necessary to bring the equipment up to standard.

Thus, the engineer must have a scientific mind to qualify him "in the art and science of applying the law of the natural sciences to the transformation of materials for the benefit of mankind." He must have the mental attitude that will allow him to persist in long study and attain a high level of scholarship. This must be combined with initiative and self-reliance which will make it possible for him to attack difficult problems and stick with them until they are solved.

EXPECTATIONS FOR TECHNICIANS

Technicians must have a basic knowledge of science and a mastery of technical skills. Examples include the handling of X-ray machines, attending telemetry monitors, checking launch rockets during countdown, testing missile components, or running a computer complex. Technicians work closely with scientists and engineers, but they work more with the practical aspects of using and testing the space equipment than with the theory involved in building it. Technicians, therefore, are not required to have such a high level of competency in mathematics (excepting mathematics technicians who assist mathematicians, statisticians, and computer experts) as do engineers and scientists. Technicians may not hold a college degree, but they often have the equivalent of two to three years of study beyond high school. This training may be obtained in college, technical school, vocational school, or in a combination of these.

The technician also has skills for keeping accurate records of the results of his work. As he works on a project, his report may include photographs, sketches, models, compilation of figures, and written records. Such reports must be kept carefully to meet standards sufficient to turn over to the scientists and engineers with whom he works. It is equally important that the technician have the ability to work closely with scientists and/or engineers in the development and perfection of equipment to be used in solving problems. The technician often carries out the detailed aspects of solving the problems that confront space workers. However, as technicians with more training and experience appear and as fields of study become more specialized, technicians are now formulating their own problems and devising ways to solve them. Thus, there are more places for technicians who have the initiative to work on their own in the solution of very specialized problems.

WHAT IS EMPHASIZED IN THE REQUIREMENTS FOR SCIENTISTS, ENGINEERS, AND TECHNICIANS?

Selected Scientists and Their Requirements

As you know, there are several major science areas, e.g., physical sciences, the earth sciences, biological sciences, and mathematics.

Physical Scientists

The physical sciences deal with the basic laws of the physical world. The four specialties included in the physical sciences are chemistry, physics, astronomy, and metallurgy. Details pertaining to three of these major categories—chemistry, physics, and astronomy—follow.

1. *Requirements for Chemists.* Chemists usually hold the bachelor's degree with a major in chemistry. Often, however, many chemists do graduate work in chemistry to qualify for positions in research and teaching. Bachelor degree chemists will usually meet the requirements for a position in analysis and testing, quality control, technical service, or as a trainee to do laboratory research and development work.

Chemists who hold the master's degree often meet the requirements to do applied research and hold teaching positions in colleges and universities. The Ph. D. in chemistry is qualified to do basic research and hold teaching positions in the college or university.

Courses that are included in the program for a college major include quantitative and qualitative analysis, inorganic, organic and physical chemistry. Courses in physics, biology, English, foreign language, and mathematics (usually analytical geometry and calculus) are also included. Beyond the undergraduate degree, the chemistry specialist will take courses in a field of specialty. The advanced degrees emphasize laboratory research, library research, and the preparation of a thesis and/or a dissertation.

2. *Requirements for Physicists.* The minimum requirement to enter a career in physics in the bachelor's degree with a major in physics. The doctor's degree is a necessity for those interested in high level research positions. Those holding the master's degree may qualify for certain research positions and teaching assignments.

The courses usually included in the physics curriculum are mechanics, electricity, and atomic physics. Courses in mathematics and chemistry are also required. Graduate programs in physics continue from the candidate's basic background, emphasizing special interests in physics, including research and the thesis and/or dissertation.

3. *Requirements for Astronomers.* In astronomy, an advanced degree is a necessity for most careers, and the Ph. D. is the most advantageous degree to hold. The Ph. D. is required of those pointing toward research and teaching positions in astronomy. The bachelor's degree in astronomy is suitable for the person starting a career in astronomy; the higher degrees are necessary for advancement.

The undergraduate curriculum in astronomy includes physics, mathematics, astronomy, and a reading knowledge of a foreign language. Other courses most helpful are chemistry, electronics, and statistics. The undergraduate will also take astrophysics, astronomical techniques and instruments, optics, spectroscopy, atomic physics, calculus, differential equalitions, and solar and stellar systems.

The graduate student in astronomy will take advanced work in astronomy, physics, and mathematics. Some specific courses included are celestial mechanics, galactic structure, radio astronomy, stellar atmospheres and interiors, and theoretical astrophysics. The graduate work for a doctor of philosophy degree usually requires reading knowledge of two foreign languages.

Earth Scientists

The earth sciences are involved with studies and research related to the history, composition, and characteristics of the earth, its oceans, and its atmosphere. Examples of earth scientists are geologists, geophysicists, meteorologists, and oceanographers. We will consider the meteorologists in more detail.

The usual minimum educational requirement for a meteorologist is a bachelor's degree with a major in meteorology for those beginning in weather forecasting. Others who have a bachelor's degree in related science or engineering with courses in meteorology are often qualified for beginning positions in meteorology. Those who plan to teach or do research in meteorology will be expected to obtain the Ph. D. degree. This will require advanced courses in meteorology, physics, mathematics, and chemistry while the bachelor's degree in meteorology includes meteorology and more basic courses in physics and mathematics. Those who work toward graduate degrees in meteorology are assigned to actual practical work in meteorology which provides a climate for various research studies. This work requires ability in both the physical sciences and mathematics.

Biological Scientists

Biological scientists are involved with study and research in the realm of living things which includes plants and animals ranging from bacteria, to protozoa, to earth worms, to molds, and includes man. This work includes extending the knowledge about living things, as well as practical application of knowledge to life processes. Included in the biological sciences are botany, microbiology, zoology, agronomy, anatomy, biochemistry, biophysiology, embryology, entomology, genetology, horticulture, husbandry, nutrition, pathology, pharmacology, physiology, and phytopathology.

Individuals who plan to specialize in one of these fields should plan to obtain the Ph. D. degree in their field of interest. The bachelor's and master's degree with a major in a particular field will also prepare a person to gain beginning jobs in the field. The Ph. D. degree is usually required, however, for the higher level teaching and research positions in the biological field.

Biological science students will need a broad undergraduate background in many branches of biology along with related work in the other sciences. Courses especially helpful are organic and inorganic chemistry, physics, and mathematics. Mathematical competency required will vary depending on the field chosen and the level of specialization to which the individual aspires. Other increasingly valuable courses are statistics and biometrics. Research techniques including the use of equipment both in the laboratory and in the field are very important.

Graduate degrees in biological fields involve advanced courses in one's special field, as well as fieldwork, research, studies, library research, and the preparation of a thesis and/or a dissertation. Keen interest and curiosity about living things, as well as abilities in observation and logical thinking are needed by those aspiring to work in biological fields.

Mathematicians

Mathematics as a field of science is one of the oldest and is regarded as one of the most basic. Mathematics can be a field of specialization in itself, but it is also extremely important and essential as a tool in many fields, such as science and engineering. The application of mathematics to many fields of endeavor has increased recently as a result of advances in electronic computing.

To enter the field of mathematics, the minimum requirement is a bachelor's degree with a major in mathematics. Advanced work in mathematics will require graduate degrees. The Ph. D. degree is a requirement for high-level teaching in college and advanced research work. The bachelor's degree is sufficient for assistant mathematician positions for research assistantships, and many computer-related jobs. The person who has competency in mathematics and physics, engineering, or other sciences may qualify as an applied mathematician. Others who have training in numerical analysis and programing have qualifications desirable in the computer field.

Engineers

There are a number of branches of engineering. The more traditional branches are aeronautical, agricultural, ceramic, chemical, civil, electrical, industrial, mechanical, metallurgical, and mining engineering. A new engineering field is aerospace engineering, a field which has come into being as a result of space-age activities.

Most engineers specialize in a particular branch of engineering. However, there is a large body of knowledge and methodology that is common to all of the fields. It is thus possible for a person to explore the common aspects of engineering and then focus on the special field that interests him. Two areas of great emphasis in all engineering fields are mathematics and the physical sciences.

To enter most engineering positions the bachelor's degree in engineering is usually required. It is also possible that graduates in physics, one of the natural sciences, or mathematics may qualify for certain engineering positions. Occasionally persons who have extensive training and long experience may enter engineering positions without the degree. Graduate degrees in engineering are important in teaching and research positions.

Most engineering schools offer a four-year program which includes mathematics, physics, chemistry, English, social sciences, and the humanities as the foundation. The foundation courses are followed by engineering courses. A number of other schools offer a five-year program in engineering. It is also possible in certain schools to take one's early work in a liberal arts school and then transfer to an engineering school. Another alternative in meeting the requirements is through a cooperative school. Under this plan the student alternates attending school and working in industry. This alternative plan takes five or six years to complete.

All the states and the District of Columbia have laws that set forth the requirements engineers must meet to be licensed when their work involves life, health, and property. These requirements usually are graduation from an accredited engineering program, at least four years' experience, and a satisfactory score on the state examination.

Technicians

This section is devoted to those technicians who work with engineers and scientists. (Other technicians are related to the health field, which includes medical technologists, dental laboratory technicians, and dental hygienists.) Examples of the technicians who work with engineers and scientists are aeronautical technicians; air-conditioning, heating, and refrigeration technicians; chemical technicians; civil engineering technicians; electronic technicians; industrial technicians; mechanical technicials; metallurgical technicians; mathematics technicians; biological technicians; agricultural technicians; instrumentation technicians; safety technicians; draftsmen; and surveyors.

To meet the requirement to work as a technician who assists engineers and scientists, a person can get his formal education in a number of settings. Some of these settings are technical institutions, junior colleges, community colleges, extension branches of universities and colleges, technical high schools, vocational high schools, and certain comprehensive high schools. The educational program will often be a two-year technical program beyond the high school or its equivalent. The courses involved are science, mathematics, technical courses related to the specialty, and technical experience in the laboratory or on the job. It is also possible to meet the requirements by on-the-job training under the supervision of an experienced technician or the supervision of a scientist or engineer. It is also possible to combine education, training, and experience in several of the above settings to meet the requirements.

The student interested in gaining admittance to a technical training program is usually required to have obtained a high school diploma. Some technical schools will admit a person who has not graduated from high school if he can demonstrate through examinations the necessary qualifications. It is possible in some cases for interested and qualified students to attend night school or other schools to make up deficiencies, such as in science or mathematics.

Technical training schools above the high school level emphasize such courses as laboratory techniques, science, mathematics, and engineering. Students are also given practical problems to solve such as the type they would meet on the job. Students are prepared in the use of instruments, machinery, and tools that relate to their specialty.

Before selecting a school for training for a particular technical specialty, a student is well advised to explore the types of jobs that graduates of the school are able to obtain. It is also necessary to gather information about the accreditation, faculty, acceptability of credits, and length of time the school has been in operation.

WHO CAN HELP YOU LEARN ABOUT REQUIREMENTS?

Requirements are difficult to pin down and they change as the jobs do; therefore, you will want to consult with different persons who can help to give you more up-to-date information about the competencies you should have to become a scientist, engineer, or technician. The following is a list of those to whom you might look for help.

Your Teachers

Your teachers can help acquaint you with the requirements that are necessary in certain fields. Teachers who can offer special assistance because of their backgrounds are:

Science teachers: Your science teachers will have studied such science courses as zoology, botany, physiology, physics, chemistry, psychology, and astronomy. They will thus be able to discuss with you your interest in these subjects and explain to you how you can learn more about them.

Mathematics teachers: Mathematics teachers will have studied courses pertaining to the theory of numbers, algebra, geometry, trigonometry, calculus, and differential equations. They can thus discuss with you how to pursue your interests in mathematics.

English teachers: Your English teachers will have studied technical writing, literature, composition, speech, and language structure. They will thus be able to advise you on how to improve your language skills and pursue your interests by writing and reading.

All of your teachers will, in fact, be helpful to you in your consideration and discussion of questions that pertain to their special fields.

Your School Counselor

Your guidance counselor is especially trained to help you explore the requirements of career fields, to assist you in learning about your qualifications, and to help you in planning your goals. Your counselor will have literature which you can use pertaining to careers; he will be able to help you select tests and inventories to learn more about yourself; he will help you by interpreting the results of your tests and inventories; and he will be able to discuss your plans with you and assist you as you prepare an outline of your plans for now and the future.

Your Parents and Friends

You will, of course, continually be discussing the development of your plans with your parents. Your parents may be able to assist you in visitations to colleges, universities, and technical and vocational schools where you can explore requirements for careers that interest you. Friends of your family who are in occupations related to your field of interest can also help you learn more about the occupation and its requirements.

Employers

Your employers, as you hold part-time jobs, can assist you in learning about that particular occupation, and also about other related occupations. Other persons who have a great deal of information on occupations are workers in employment agencies, both governmental and private. You can make an appointment to see an employment interviewer and he can help you explore occupations and occupation requirements.

WHAT OTHER WAYS CAN YOU LEARN ABOUT REQUIREMENTS?

Personal Exploration

You can set out on your own to learn more about requirements. You could go to the library and look up occupations that hold special interest for you. You will thus find the books and articles that are available on the topic. You can then set up a plan to read some of the materials. In these publications you can look for leads to other materials you can read. You will also find addresses of organizations and societies that relate to your career interest. As time permits you can write to these organizations and request information they have to offer. These materials will give you more leads.

Institutions of Higher Learning

You might want to write to a college, university, or another type of school requesting information that they have to offer. You may wish to follow this up by making an appointment and visiting a school of interest to you. You could arrange to talk with admissions people. Various schools have different ways of assisting students along this line, but your letter to the registrar would yield an answer as to how to succeed.

Industrial-Governmental Establishments

You may wish to write or visit industrial or government establishments that relate to your career interest, either for information or to arrange visiting times. In addition, personnel in these establishments may help put you in touch with other sources of information.

Exploration Not Complete

At this point you may feel that you have explored much of the space industry. There remains, however, another important area. This is related to what you expect to get from your job, what goals you expect to reach in your life, and how you are equipped to achieve your goals. These topics will be dealt with in the next chapter. Before going on to this section, however, you may wish to complete the following guide to obtain a clearer idea of how you meet the requirements for space careers.

Science

What science courses have you taken?
How did you perform in each?
Do you need to improve?
What is your plan to improve?

	Science Courses	*Performance*	*Need to Improve*	*Plan*
1.				
2.				
3.				
4.				
5.				
6.				

What other science courses are you planning to take?

Mathematics

What mathematics courses have you taken?
How did you perform in each?
Do you need to improve?
What is your plan to improve?

	Math Courses	*Performance*	*Need to Improve*	*Plan*
1.				
2.				
3.				
4.				
5.				
6.				

What other mathematics courses do you plan to take?

Special Skill Courses—
Drafting or Electronics

What special skill courses have you taken?
How did you perform?
Do you need to improve?
How can you improve?

Special Skill Courses	*Performance*	*Need To Improve*	*Plan*
1. ______	______	______	______
2. ______	______	______	______
3. ______	______	______	______
4. ______	______	______	______
5. ______	______	______	______
6. ______	______	______	______

What other courses do you plan to take in special skills?

Helpful References

Careers in Science: A Selected Bibliography for High School Students, by Hilary J. Deason and William Blacklow (eds.). Washington, D.C.: American Association for the Advancement of Science, 1961, 23 pp.

This booklet has been designed for high school students to assist them in obtaining information on careers in pure or applied science.

Engineers Unlimited: Your Career in Engineering, by Harry Edward Neal. New York: Julian Messner, Inc., 1960, 192 pp.

This book tells the kind of work that a young man or woman can expect to do in the various engineering fields. The preparation necessary to enter is also discussed.

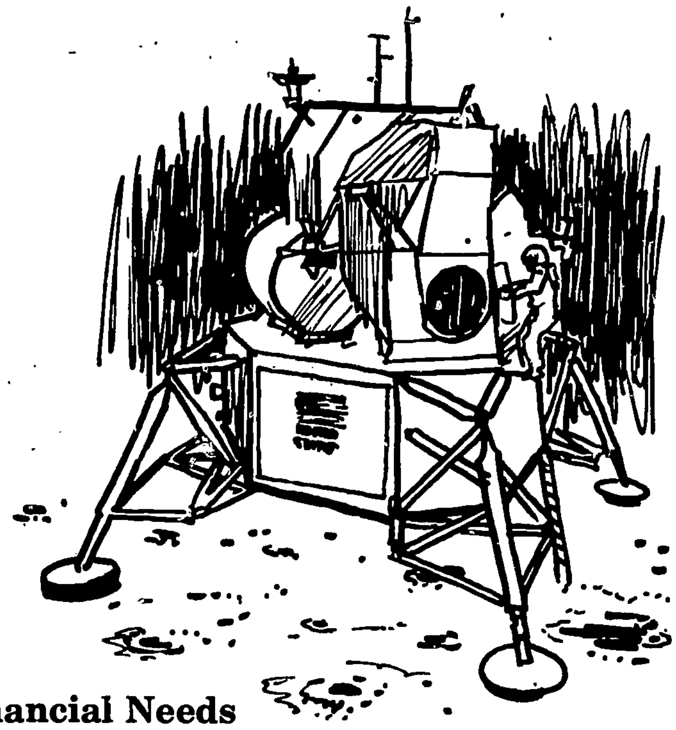
Orientation to Engineering, by A. W. Futrell. Columbus, Ohio: Charles E. Merrill Books, Inc., 1961, 250 pp.

This book discusses the profession of engineering in general, the major engineering fields, the engineer's activities, and the trends in employment for engineers.

NOTES

CHAPTER 6

FRAME YOUR GOALS FOR NOW AND THE FUTURE



What are goals and are they important?

Should you make a detailed plan for your future?

What are the secrets of success at home, at school, on the job?

When should you set goals for your life?

GOALS, WHAT THEY ARE, WHY THEY ARE, WHERE THEY ARE

Goals are steps that must be touched or skipped to reach the top. Goals are needs, real and imagined. Goals are rest stations for a longer journey. Goals are checkpoints to measure or determine one's progress, speed, and capacity. Goals apply to you—to everything you do or want to do. Since goals are needs, every time you establish or think about a need you set up a goal.

Physical Needs

There are physical needs, financial needs, social needs, and psychological needs. Some goals may temporarily satisfy several needs. Your need for food, shelter, and clothing, for example, must be satisfied by working at a profitable vocation, trade, or profession. You and your family must be provided with these essential items and at the same time satisfy many physical and psychological needs such as exercise, rest, recreation, and comfort.

Financial Needs

Our increasing standard of living is associated with spiraling costs for all types of services, equipment, luxuries, recreation, transportation, insurance, taxes, not to mention food, clothing, and shelter.

College tuition now averages near $2,000 a year for each of the four or five years necessary for a professional degree. This college cost does not include clothing, recreation, and other necessary items. Standard costs change, according to a recent study reported in *Financing a College Education, A Guide for Counselors,* published by College Scholarship Service. The cost of a college education is handled as follows:

- Parents use current income to pay for 40 to 50 percent.
- Family savings and loans cover 10 to 15 percent.
- Students use their own savings and earnings to provide for almost 25 percent.
- Scholarships provide 10 to 20 percent.

There is no ultimate standard of living that can be reached and maintained in our society. We constantly strive for more sophistication, more culture, more comfort, more of everything—and better. Our needs are constantly costing more and our goals are becoming higher and higher. More and more individuals are saving for an emergency or for retirement—financial security for an underproductive future.

Goals are important. They reflect your needs and your desires but they must be related to the cost in time, effort, and income.

Psychological Needs

For most people, more important needs than financial rewards are their psychological needs. The need for self expression, for recognition, for respect, outweighs purely monetary rewards. Happiness is often found in the realization of doing something for others. It may be found in excelling, in succeeding, and in belonging to a group. Social relations established with other workers, other students, one's family, satisfy certain psychological needs. Psychological needs, whether intellectually perceived or vaguely felt, draw one in a certain direction and influence choice of a career or a curriculum. Satisfaction depends upon the extent the job or the school meets the needs that have been felt.

Detailed Plans and Goal Setting

Goals express constantly changing needs. This does not mean that one should not have a detailed plan directed toward a specific goal. However, planning should be flexible enough so that changes can be made as more information, more awareness, and more intellectual maturity becomes evident. A list of goals should be set up for this next semester's work in school; goals should be established for out-of-school needs, physical, social, and financial. A most rewarding goal is that of establishing better personal relations with those whom one is working, living, or studying. If personal-social goals fail to be met the entire pattern may suffer. Productive goals are those that insist on personal development, on progress. Such goals are set just somewhat above the level that can be reached with normal effort.

Your goals should be flexible enough to permit change so as to provide for an unexpected opportunity or failure.

Intermediate Goals—Education for Living

Being prepared means another step forward toward success. It means being ready for a new pathway to a space-age career. To be ready a student must have thoroughly mastered the fundamentals. Before one enters college his vocabulary should be developed. Also, his reading and comprehension skills should be sharp and his knowledge of mathematics, history, and government should be extensive. Basic to mastering the fundamentals is the ability and ease to communicate clearly both in writing and speaking. This sort of preparation requires good study habits and self-discipline.

Advancement in Education or Training

Before you finish high school, establishing and achieving short-range and long-range goals should be standard activity. By the time you enter the tenth grade you should have your college program well planned. During your remaining years of high school, these plans should be refined, reduced to realistic goals, and programed with respect to financial considerations. If your plans include college preparation, the area of preparation should be outlined and discussed and considered by your counselor, parents, teachers, friends and determined to be attainable. Your college plans should relate to a vocation or a career family, a particular industry or area of specialization or professionalization. To make definite plans you really have to know yourself, your interests, aptitudes, abilities, your intelligence and experience levels, your capabilities, and your shortcomings. These data are not easy to come by. Your counselor and parents will help you if you have the intestinal fortitude to bring your thoughts, feelings, and desires out so they can be understood and discussed meaningfully.

A preliminary method of discovering what you are like and to help you plan future goals might be the writing of an autobiography. In your autobiography you could include as much information as you can about your family, your home, and your early childhood. You might also include factors about your health and you probably would explore in detail your school progress. Your interests, activities, and hobbies could also be worked in along with your occupational interests, and your work experiences. Any special personal accomplishments would also be appropriate to bring out. From your autobiography, which goes back into your past and brings you up to the present, you can get a picture of yourself. On the basis of this picture which includes your interests, abilities, and achievement, among other things, you can define your goals for the future. Goals you can reach, yet goals that will challenge you, can be determined. When you have completed writing the autobiography, have someone you trust read it and discuss it with you.

Your goals, if not college, should include immediate vocational or technical training in an expanding new career field, perhaps data processing, electronics, plastics, business machines, or automatic vending machines. The selection is important and should be matched with proven aptitude and capacity to learn.

Occupational Choice, Central Factor in Achieving Goals

For most people the choice of an occupation is the major determinant as to whether or not they reach certain goals. Thus, a person in the process of career choice should often consider the following questions. (The autobiography may be useful in answering.)

1. What occupations have I considered for my life's work?
2. Why have I considered this kind of work?
3. What are the requirements for this job?
4. What special qualifications do I possess for this kind of work?
5. In view of my choice, what should I plan to major in?
6. How should I start?
7. When should I begin?
8. What should I do first?

Today, special skills are more and more in demand, yet specialization too early may close the door to many opportunities. Thus, for those considering a career in either science and engineering, or technology, a broad academic base is most helpful to undergird the eventual specialization. The following is a list of the more basic skills that will serve to prepare the science-oriented student to go the farthest.

1. Learn to read rapidly and accurately.
2. Develop a large vocabulary for speaking and writing.
3. Learn to concentrate and remember details.
4. Learn to observe closely.
5. Learn to inquire about the why, as well as the what.
6. Develop a longer attention and concentration span.
7. Take care to read widely, as well as in depth in certain areas.
8. Learn to think critically and logically.
9. Learn to handle mathematics skillfully.
10. Learn how to maintain your best physical and emotional health.

The level of these skills will be a factor in determining just how far a person can go in science-related careers.

Acquiring Greater Skill—SQ3R

Becoming more skilled is a function of your capacity, your motivation, and the means you employ to improve your performance. You can do a great deal to improve your performance by learning more efficient study habits. Good study habits take time to develop. If you want to check on your study habits you might ask your school counselor about taking a study habit survey. If you need improvement you can get advice from your counselor and teachers. *Remember that study in a good, well-lighted properly equipped study room is the first step to good study habits.*

A good source book to use as a guide to improve your study habits is *Effective Study* by Francis P. Robinson.[1] This book presents a formula for more effective study. It is called the SQ3R Study Method. The S stands for *Survey*. The Q stands for *Question* and the 3 R indicates *Read, Recite,* and *Review*. You might try this approach with your next reading assignment. Take a segment of your assignment and survey it (look it over quickly, reading the heavy black titles and getting an idea of what it is all about). The next step is to convert these titles into *questions* which you can answer when you read the segment. After the *survey* and *question* steps you *read* the segment and look for answers to your questions. The next step is to *recite*. This can be done by looking up from your book and trying to recall the main points

[1] Francis P. Robinson, *Effective Study* (revd. ed.; New York: Harper & Brothers, Publishers, 1961).

2

you have read and answering the questions you have in mind. You might also jot down some notes covering the main points. Finally, from time to time *review* each segment you have read by thinking over the main points. You might also return to your notes and check yourself. For more detail on this method and other pointers on study, read Dr. Robinson's book. It might be wise to consult your counselor and your teachers to get further ideas and references on becoming more skilled in study.

Military Service Skills

For young men who are or may become career minded, the military service offers great opportunity. Military technical schools and off-duty and in-service educational and training opportunities offer an ideal way of preparing oneself for a rewarding future, a way that one can progress without financial support from family or friends. Modern military skills are readily convertible to civilian industry and many are identical with technical skills in the space industry, which includes space development for national defense.

Successful military service includes developing one's character, one's potential for citizenship; it provides training, education, and experience to succeed in a civilian occupation. Educational opportunities for a serviceman and even for his family are greater than in civilian life. One must, however, have and set educational and training goals—even in the military service!

Pleasant Companions

An important part of living is the friendship and companionship of fellow students, teachers, fellow workers, and employers. Happiness comes from pleasing others as well as oneself. Self-expression and personality are developmental goals which when achieved can do much to make life worth living, a job worth working for, and money worth spending. Getting along with others is important.

Reaching Your Goal—How To Succeed

Sacrifice is necessary to achieve goals. To get something you usually have to give up something. It takes directed energy to perform. It takes initiative to investigate, it takes nerve to insist, it takes inquisitiveness to ask, it takes talent to accomplish, and it takes hard work to succeed. It takes intelligence to find a more productive method, technique, or approach to learning or completing a task. Programed learning, film, filmstrips, memory courses, concentration exercises, brainstorming, and other innovations might be used to get one started, or off of "dead center." There are short cuts but there is no easy way to the top. The "stairway to the stars" is paved with school books. To learn more, you must study, not just read. The midnight oil must be burned. Hard work must become a habit long before one reports for work on a new job. Hard work at school produces more than grades—it establishes confidence that one can learn to succeed. Grades in high school and class rank, however, are the best predictors of success in college. This extra work or study may prove to you that you can succeed in spite of obstacles, real or imagined.

Tenacity is equally important with extra effort. With bulldog-like determination, a seemingly unsurmountable obstacle can become an accomplishment. Goals sometimes appear as insurmountable barriers. There is nothing like succeeding to insure success. Confidence is built on success based on hard work and intelligent planning. To do these things one must have self-discipline. Here is a formula for success based on self-confidence.

A Working Formula For Success

To be very practical about this matter of succeeding, here is what you have to do: *First,* determine specific goals to be met in a given length of time. *Second,* require yourself to meet or surpass that goal by concentrating on it for __ number of minutes each day, seven days a week. *Third,* evaluate your results as you go along and again when the set length of time has passed. *Fourth,* critique yourself to improve your concentration, then increase or decrease the time spent based on new goals and time limits.

For example, let's say that you wish to make a B+ in English literature during the next six weeks. You arbitrarily determine that you are going to study twenty-seven (27) minutes each day in English literature, concentrating on it and it alone, and using all the study aides, device, and techniques you know. Each week you will stop for, say, seven minutes and evaluate your progress and at the end of the six weeks you will measure your effort against your grade.

The magic of this system lies in your *not telling your parents, your teachers,* or *your friends* what you are doing so they can monitor your adherence or evaluate your dedication. *You and only you set the time limit* (27 minutes), *the goal* (B+), *and the degree of concentration* (all out utilization of concentration and study habits). *You and you alone can appraise the results* and make the necessary changes. The magic is that you will either increase the time limit to reach the goal, raise the goal to, say, an A−, or seek improved study and concentration habits, possibly all three. If you religiously adhere to this self direction you will prove to yourself that goals you set are attainable. You will have developed a security of self discipline that can be channeled into every activity in life. Your confidence will be based on hard work and you will realize new values for time and for efforts and have proved to yourself that you can do what you determine to be important.

**Planning Your Work—
Following Your Plan**

As you plan your work, do you try to improve your planning itself? Do you take time to evaluate how much you are accomplishing; how much time it is taking? Step by step, your plan and your work should take you along a pathway leading to a desirable goal. As you evaluate and discuss your progress, there may be reason to change pace or change to a more logical sequence. Sometimes a self-inflicted punishment or self-directed reward will provide an additional challenge.

Careers in science, engineering, and technical areas require logic, system, and common sense. A "check list" approach to a task often meets these requirements.

Considering the difficult level of the material you study may make your plan easier and your approach more systematic and simple. The six levels of learning are (1) knowledge, (2) comprehension, (3) application, (4) analysis, (5) synthesis, and (6) evaluation. The highest level evaluation means comparing and forming judgments or placing a value on your feeling toward a fact. Synthesis, simply stated, means putting related and unrelated facts or things back together, forming a whole. Analysis means to take them apart and look at them. Application means the ability to use what is understood or comprehended. The lowest level of learning is knowledge or recognition and remembering .

These factors should be considered in your study habits along with the SQ3R method of study and the scientific method of problem solving previously mentioned. What level of learning offers you a challenge?

Become Research-Oriented

There are things that one must do to begin to prepare. As you read and study and visit and talk with people in the world of work you collect facts. Don't lose them! Write them down, cut them out, label them, and put them to use. Collect and classify all sorts of data, analyze those that you think fit your needs or contribute to your growth.

Good tools are important to any trade. Buy a good dictionary, a set of encyclopedias, a slide rule—and use them. Start your own personal reference and research library. Get or make a drawing board and obtain drawing instruments. Get your own typewriter and books, *lots of books*. Learn to read widely, critically, extensively—and look up what you don't understand. Catalog your books in your own library just like the technical or standard library at school. Do it yourself, so you will know it's done right.

Question everything you hear or read and demand explanation and verification. Continue your education; expand it. Take an evening class at a university or college; or go to a nearby college *before* you enter college. Attend summer school or a summer college workshop or a seminar. Start a research project or science project of your own, and, most important, *finish it*—with all the precision and pride that you can muster.

Prepare a paper for publication. Put down the facts of a favorite item you have investigated, as you see them. Organize them into an outline. Build them into useful, understandable data, test them, and write them for publication. Technical writing is a very important part of science, engineering, or other space-related technology.

Seek leadership roles. If you are to succeed you must gain experience in following and in leading—in groups, interacting with others. You may be interested in science clubs, discussion groups, politics, civic clubs, college clubs, or perhaps a speech club, like Toastmasters.

To frame your goals now and in the future you must learn to *think, communicate,* and *cooperate*. Here is a checklist to help.

A Checklist for Goal-Reaching

1. Make a list of five goals for this month, five goals for next semester, and three goals for next year at this time.
2. Make a detailed budget for your first year's expenses in college and research every item.
3. Make a list of people whom you dislike, whom you like, and those you want to like you. Figure out why you have included or excluded certain people.
4. Prepare a detailed schedule for one week—day-by-day, hour-by-hour—and note what items you accomplished or missed doing.
5. Write for five college catalogs and for information about five possible careers.
6. Try the SQ3R study technique for a six-week period.
7. Try to gain a new friend and get along happily, with everyone you meet on a particular day each week. Study your technique for being successful at this.
8. Make a list of ten books that you want to own. Check them out of a library. Read two of them.
9. Make a list of tools, materials, and supplies that you would like to have for your research laboratory and library.
10. Make a checklist of the various things that you plan to do this month and next month and post it where you can see it often and where you can change it, if *you* need to.

Helpful References

The National Geographic Magazine is the monthly publication of the National Geographic Society, a non-profit scientific and educational organization for increasing and diffusing scientific knowledge and promoting research and exploration. National Geographic Society, 16th and M Streets, NW., Washington 6, D.C.

Rocket Encyclopedia, Illustrated, by John Herrick and Eric Burgess. Los Angeles, California: Aero Publishers, Inc., 1959.

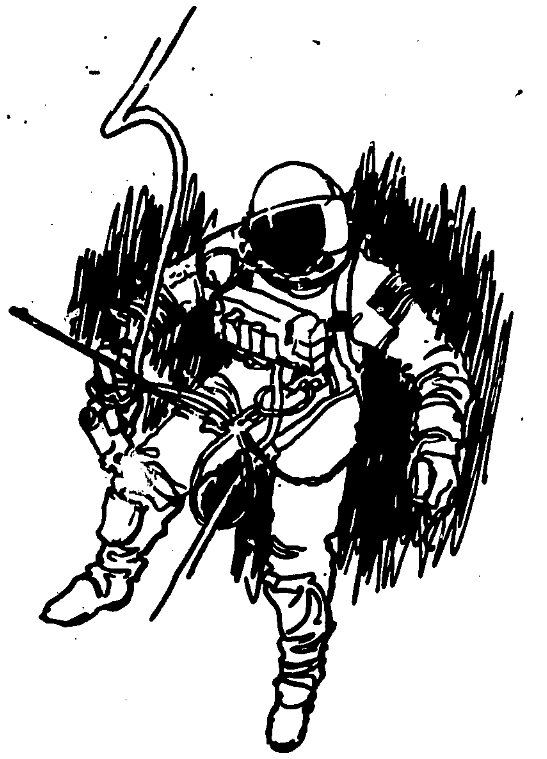
This encyclopedia provides authoritative and comprehensive facts and theory about rockets, rocket assemblies, components, accessories, manufacturing machinery, test and ground equipment, and production methods.

The Space Guide Book, by William J. Weiser. New York: Coward-McCann, Inc., 1960.

This book provides explicit answers to clearly stated questions focused upon current information of all the sciences related to space. It skillfully translates complex scientific data into clear and simple language the student can readily use.

CHAPTER 7

LOOK TOWARD EXPANDING HORIZONS



How can you keep up with the trends?

Is your training preparing you for a lasting career?

What is the outlook for the career you have chosen?

How will your career fit into the space program?

For hundreds of years people have been saying, "There is nothing new under the sun," that "the sky is the limit," and other such nonsense while space-age science has passed them by. In fact, few of us are aware of how far and how fast we have advanced. Few of us have kept up with the changing times.

TRENDS

Trends are indications of change. Trends are made from careful studies of the past and the rate of change can be used to predict the future. We live in a continuously changing world and if we are not going to become obsolete we must look ahead.

OCCUPATIONS CHANGE. The Department of Labor, Bureau of Labor Statistics, 1963–1964, *Occupational Outlook Handbook,* reports changes in the world of work taken from decennial census reports and monthly labor force surveys. Factors reported also reflect data from their Bureau of Apprenticeship and Training. There are many facts to consider.

Of the nearly 192 million people in the United States, seventy million are employed. Two students out of every three who enter school will graduate from high school. Only one out of every 29 persons in their early twenties has a college degree yet the trend is that college enrollment will continue to rise.

AUTOMATION vs. UNEMPLOYMENT

Automation eliminated some 2,000,000 jobs last year. In 1963 there were 3,000,000 new jobs but unemployment was not affected. The exploding population and the drop-out rate of undertrained, poorly educated youth swell the nation's unemployment rolls.

The duration of unemployment has increased sharply since 1957 while the rate of growth in gross national product and employment has decreased in the past five years. To contrast this, professional, white collar, and skilled occupations continue to expand rapidly, while the semiskilled and unskilled groups show little or no change.[1]

Studies for several years have shown that workers with more education and training are employed in better jobs—a simple statement, but consider how it applies to your career choice.

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[1] *Manpower Research,* Bulletin 2 (March, 1963), U.S. Department of Labor.

Training programs should be realistically oriented toward present and future labor market requirements. This is particularly important because of the continuing decline in the number and kinds of jobs which youth with low levels of training and education can fill.

Even though the most dramatic change in the labor force in the 1960's will be the influx of young workers, and the largest increases in employment by 1970 will be in the service-producing industries, the major demand in the next decade will be for professional and white-collar workers.

The fastest growing occupations during the next ten years will be the professional and technical positions, especially engineers, scientists and technicians, and white-collar, clerical, and sales people.[2]

The Federal Government is the largest employer in the United States and most of its employees are civil service employees. Seventy percent of the civil service employees are white-collar workers or executive, managerial, or supervisory positions. Only 14 percent of these white-collar positions are professional, however.

The National Aeronautics and Space Administration (NASA) estimates that 20,000 companies and 3,000,000 people will participate in the space conquest by the end of this century.

NASA now operates from ten major centers and employs about 35,000 people, mostly in the skilled or professional or administrative areas. NASA's work includes basic and applied research for the expansion of human knowledge of phenomena in the atmosphere and space; the improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles; the development and operation of vehicles carrying instruments, equipment, supplies, and living organisms through space; and the preservation of the role of the United States as a leader in aeronautical and space activities within and outside the atmosphere. Civil service salaries for career-professional people start around $7,000 per year and extend above $20,000, plus many retirement, vacation, educational opportunities, and other benefits.

[2] *Ibid.*

Average annual earnings in 1962 in private industry are comparable:

- Physicist, about $7,000 to start, $10,000 with experience, top $18,000 or more.
- Chemist, start about $6,000, with experience, average $11,000.
- Geologist, $5,400 with B.S.; $5,000–$10,000 M.S.; $7,500–$10,000 Ph. D.
- Plant Scientists, $5,000 start; $7,000–$12,000 with experience; top $20,000 or more.
- Technicians, start at about $3,500–$5,000; $6,000–$8,000 with experience; top $8,000.
- Meteorologists, start at $5,500; with experience $7,000–$12,000, average $9,000; top $25,000.[3]

COMPUTER–AUTOMATION

One new computer the government is using, the Univac 1107 Thin Film Memory System, can tabulate 3,000,000 items a minute as compared to 30,000 items for a 1950 model. Since 1950 computers have proven themselves so efficient that today we are using some 15,000 units, some capable of remembering 17 billion different facts. They are being used in every major industry.

One thousand newly-trained computer personnel may be required each month to supplement those already skilled. Some 60,000 are needed immediately. Approximately 45,000 Federal employees were involved in the operation of automatic data processing units with computers in 1963. They were located in 29 separate states and in 16 other locations outside the United States.

This is an explosive age. The explosion of knowledge has placed science and technology years ahead of society. The population explosion increased the need for better standards of health, education, and welfare; for a better distribution of new and better products. The standards of living are increasing; prices of goods, cost of labor, and levels of education are being raised, but unemployment remains. The cost of education is climbing but educational

[3] *Jobs in Science*—Job Family Series #1, SRA, 1958, 1963

programs, particularly vocational and technical training programs, remain inadequate. People are getting married and seeking employment earlier and living longer than ever before. Women are competing with men in all areas and doing a good job of it. Even the combined income of man and wife does not insure a college education or a profitable career for "junior" unless prior preparation and choice of such a career is based on the study of occupations—what they require and what they offer.

The pattern of man's work has changed. A space-age career will probably require a series of different jobs, each requiring an acquistion of a new skill. Even within the same occupations, the space industry will demand continued periods of education, training, and retraining to keep pace with the changing times. Young job seekers will find that, regardles of what job fields they choose, opportunities for employment and advancement are directly related to the quality of preparation and the kind of skills they possess.

Success will often depend on inventiveness, ingenuity, communicative skill, and personality. Success will always depend on hard work.

THE CHALLENGE OF CHANGE

Great things lie ahead in science and in space exploration and development. Undreamed of advances in industry will occur! Several years ago, Dr. Wernher von Braun declared that travel to the moon would soon be a matter of routine. He predicted that we would have a permanent moon base, with dozens of people living there all year round similar to the permanent research station we now have at the South Pole. Von Braun also predicts a manned expedition to Mars by 1983.

Most space experts agree to this timetable but many believe new breakthroughs in power, energy, fuel, medicine, and other areas may very well shorten the date, since bigger and better computers will help manage this space age.

All of this is important to you and your educational and vocational plans. You must become alert to these changes but, more importantly, you must keep up with the trends. If not, you may be left behind. Thousands of students are spending hundreds of thousands of hours and dollars preparing for occupations that are becoming obsolete. Hundreds of thousands of school drop-outs and the under-educated, undertrained, unskilled, or semi-skilled are unemployed and will remain so unless they go back to school or retrain. Such people will face continued unemployment and poverty. The costs of living, the cost of education and training will continue to rise, but so will salaries and career opportunities for the experienced technician, the engineer, the scientist, the educator, and other highly-skilled or professional personnel. The future promises great adventure and psychological fulfillment in their work.

Whether you achieve your well-planned goals and reach the expanding horizons of success in a space age will depend on the decisions that you make now! One of these decisions, perhaps the most important in your entire life, will be your choice of a satisfying and rewarding career. Accept the challenge of today for better living today and tomorrow.

Helpful References

Careers and Opportunities in Astronautics, by Lewis Zarem. New York: E. P. Dutton & Company, Inc., 1962.

This book is a guide to the challenging opportunities and professional jobs in all branches of the the science and technology of space flight.

Fundamntals of Guided Missiles, Air Training Command, U.S. Air Force. Los Angeles: Aero Publishers, Inc., 1960.

This text contains comprehensive technical data about missiles and guidance systems including a glossary of "Guided Missile Terms."

Spacecraft, By James J. Haggerty, Jr. New York: Scholastic Book Services, 1962.

This book was published as a joint project of The National Science Teachers Association and the National Aeronautics and Space Administration. The book was designed at the request of students and teachers to provide a better understanding of careers in science and the technological society in which we live.

SUMMARY

RENDEZVOUS WITH A SPACE CAREER

The coming together of two space flight vehicles for a rendezvous in space is an extremely difficult feat to accomplish. To achieve a rendezvous in space, the course of the first vehicle of the two to put into orbit must be carefully determined. A careful plan must next be devised to launch the second vehicle into an orbit, such that, after the two vehicles have orbited for a time, they will come extremely close together. The obtained orbit of the second vehicle may require some correction. The error in orbit can be corrected if it is not too large and if it can be corrected early. The uncorrected error will result in greater and greater error if undetected and corrected early. Very slight errors, however, can be corrected as the vehicles near one another in their orbits.

If all of the planning, application of knowledge, and equipment functioning is within certain limits, the coming together of the space flight vehicles will be achieved. The vehicles can then be attached and orbit on together.

This oversimplified view of space vehicles rendezvousing can be compared to your career choice process. Think for a moment of careers as space vehicles orbiting around the earth. The vehicles travel around and around and you might not even be aware of their presence, as you are not aware of certain careers. One day, *today,* you are *Alerted* to the presence of the orbiting careers. You start to think about going into a space career. This means you will have to rendezvous with a space career, and this is a difficult feat to achieve.

You decide to go ahead and you *Begin to Explore the Space Industry.* You learn about who is in it, where it is, and its history. If you are to come together with a space career you know that you must focus in on the orbits of the space careers. Thus, in greater detail you *Consider the Occupational Fields of the Space Industry.* It is critical that you know the kinds of things that people in space careers do and the kinds of problems they must solve. Once you have plotted the course of some space careers that interest you, you must focus on yourself and your qualifications. It is time to *Determine a Pathway* that will bring you *Together with a Career in Space.* You thus think about and explore different educational and training programs.

It so happens that you were already in orbit when you became alerted to space careers. Now, the question is, can you adjust your orbit enough to come together with the orbit of a space career? You must check your orbit to see if it is high enough in ability to reach the level of scientist, engineer, or technician. You must check your apogee of interest in space careers and your perigee of personality to see if they are not too far out to bring you together with a space career. What about your orbital speed or achievement in science, mathematics, and technical skills? Which type of career in space does your achievement qualify you for at present? Remember that you can correct for error but that large corrections must be made early. So if you are to have the background you must get the science and mathematics while you are still in high school to prepare for advanced study.

You can make some small corrections later on in your flight, but usually only small changes in your orbit can be achieved the longer you are in orbit.

To make these small changes, more information will likely be needed. Thus you will want to analyze more carefully the orbits of the space careers. In other words, you will want to *Examine Job Requirements in the Space Industry.* As the gap between your orbit and that of the space career narrows you will want to keep making corrections in your flight plan. This will require that you *Formulate Your Goals for Now and in the Future,* in terms of your objective(s) in life, as you view them more clearly.

Once you get close or have *Rendezvoused with a Space Career* you will be in a position to better view the *Expanding Horizons.* At this point, though, those who have gone into orbit are reporting back the likely trends for space careers. They have reported *Expanding Horizons* and they also point out that farther out in space there is no horizon. This means the opportunities and expansion in space careers are expected to go on growing without end. Other career fields, such as coal mining, steel industry, and petroleum engineering, have begun either to decline or are expected to do so in the future. Space career opportunities will continue to increase. Will your career development be in space science and technology?

NOTES

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